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A Case of "Idiot Savant:" An Experimental Study of Personality Organization

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A CASE OF "IDIOT SAVANT;" AN EXPERIMENTAL STUDY OF PERSONALITY ORGANIZATION

I. The Case of L*

FIRST IMPRESSIONS

In 1937 an 11 year old boy, L. was presented by his mother to the writers for neuropsychiatric and psychological consultation. The complaints about L. summed up to this: he could never follow the regular school curriculum, like a normal child, or learn by instruction. His general information was alarmingly sub-standard; he had made progress in only a few school subjects, and even in these, his achievements were very limited. His motivational and behavior peculiarities had been an early concern of his parents. He had never shown interest in his social surroundings or in normal childhood activities. On the other hand he had always excelled in certain performances.

Medical examination showed him to be healthy and physically well-developed with no signs of neurological disturbances and with a normal EEG record. Follow-up examinations from his 11th to his 16th year, including laboratory tests, pneumoencephalography, showed no physical abnormalities. The following description of L. is based on a great number of observations and examinations made during the years 1937 to 1943.

The first impression on meeting L. is that of an erratic and hyperkinetic child, driven by an urge to keep in constant motion. He seems also to be governed by an ever recurring impulse to move all four fingers of each hand rapidly in a definite beat, rubbing them against the thumbs (in a snapping-like motion without the snaps). Alternating with extreme inattentiveness, self-preoccupation and restlessness he displays a friendly poise and stereotyped politeness, as when responding to or addressing people. Most of the time L. appears motorically or otherwise self-absorbed and socially aloof. However, he shows one unique interest in his human surrounding—an amazing phenomenon exhibited in the first minutes of the examination. Spontaneously the boy asks each of us, "When is your birthday?" Given the date, he answers in a fraction of a minute, "Dr. G.'s birthday was on Saturday last year and Dr. S.'s birthday was on Wednesday." A glance at the calendar proves him correct. We call others to the scene, and with amazing swiftness, L. gives correctly the day of the week of every person's birthday. Moreover, he can tell at once exactly which day of the week a person's birthday was last year or 5 years ago, and on what day it will fall in 1945, etc. More closely examined, L. proves capable of telling the day of the week for any given date between about 1880 and 1950. Conversely, he can also give the date for any given week-day in any year of that period, e.g. the date of the first Saturday in May 1950, or of the last Monday in January, 1934, etc. As much as we could determine he makes no mistakes in his calendar answers. Though L. unquestionably takes delight in the recognition of his feat, he never seems aware of its extraordinary character in the same sense as a normal person (e.g.,

* This case was investigated jointly by Kurt Goldstein, Eva Rothmann and Martin Scheerer. A preliminary report of the findings was made in a paper read by Dr. Goldstein to the Eastern Psychological Association at Providence, R.I. in 1942. The text of this monograph was prepared by Dr. Scheerer.

the reader of this, if he could master such a task). On the other hand, it is known that, since his 7th year, he had developed a persistent interest in the birthdays of everyone he meets. For some time he has been surprising people he met only once before by volunteering their birthdays "on sight." This, of course, happened to the writers on many occasions. In conjunction with this specific memory he almost inevitably will know the day and date of his first visit to a place and usually the names and birthdays of all people he met there. He never fails to look for the date when he sees a newspaper, which otherwise does not interest him in the least.

This specialized interest and retention of L. is coupled with an impressive skill in rapidly manipulating and retaining *numbers*. His span for immediate recall is 7 digits forward and 6 backwards. He can also add up correctly the total of ten to twelve 2-place numbers just as quickly as one can call them out. In other respects his arithmetic achievements appear on the surface to be normal for a child of his age. Except for an unusual speed in those calculations which he can execute, he does not show any superiority. On the contrary, he makes errors in multiplying, adding or subtracting larger numbers although he has received instruction in arithmetic. Here, as in other subjects, appears an inherent difficulty in learning by following instructions and explanations in a systematic way.

This kind of memory organization is indicated by L.'s performance in *spelling*, for which he shows an affinity similar to that for counting. He correctly spells many words *forwards and backwards*, orally or in writing. He will usually ask how a word is spelled when he hears it for the first time, and will never forget it. A word not taught to him this way he will spell out phonetically without hesitation. In contrast, he never inquires into the meaning of a word, so that he knows the spelling of many more words than he knows the pertinent meanings.

L.'s rigid trend towards developing skills and knowledge only on his own limited terms of play-like function and sheer manipulative interest reappears in his *musical ability*. He shows a surprising musical capacity and sensitivity together with equally surprising gaps. He has absolute pitch, likes to play the piano for hours without being taught. Although he has learned to read simple scores, he plays *only by ear*, e.g. such melodies as the "Moonlight Sonata" or "Three Blind Mice," and later, at 14, more difficult compositions, e.g. the "Largo" from Dvorak. Mostly, however, he will play monotonous sequences of his own fancy. He will rarely reproduce a tune he knows and then only on insistent demand. He loves the opera "Othello" to the degree of obsession, and can sing the "Credo," "Si ciel" and the "Adagio Pathetique" from beginning to end. He sings the accompaniment or the Italian words as they sound to him. Without knowing the language he reproduces it purely phonetically. His interest in music includes a preference for the operas of Verdi, for Beethoven, Schubert and Tschaikowsky, all of whom he likes to hear on records. He prefers a victrola concert to music from the radio in which he never showed interest. He is able to recognize and place a heard composition, to identify its name, and to complete a melody if he hears a part of it. At 12 he was taken to a competent musician who played a piano piece unknown to him. Asked to repeat it, L. did so, according to the musician, amazingly well . . . the

melody correct, the accompaniment adequate. In contrast, L. never has profited from any systematic musical training. He has always refused to learn piano pieces by reading the scores, and would not pay any attention to them. He would never practice a composition nor readily repeat his musical performance on demand, and would not correct his mistakes when told to do so. It is not even certain whether he did grasp the errors which were pointed out to him. If he heard the same composition several times, he would improve his playing of it but he never seemed to improve through practice. Occasionally he sat at the piano and played what appeared to be short compositions, but it was never possible to make him repeat them so that they could be fixated. Yet words and names related to music he retained almost indefinitely.

Apart from this mixed picture of positive specific performances and intellectual handicaps it should be noted that L. scores an I.Q. of 50 on the Binet. From this brief review, a number of questions arise: How are we to assess and to explain these discrepancies in L.'s achievements and in his personality structure? How can it become intelligible that an imbecile appears normal, indeed, supernormal in some specific abilities, and sub-normal in practically all others? How are we to understand the absence of a normal repertoire in motivation, interests and social responses, together with the presence of abnormally intense, specialized propensities and impulses? And how does this fact harmonize with the lack of normal capacity to learn, even in those fields where proclivity and performance are notable? Obviously the term, "idiot savant," conventionally applied to such cases, poses more of a problem than it affords an explanation.

All these questions are ultimately rooted in the problem of personality organization and that of intelligence; they reopen the problem of the degree of interdependence of functions, and of their specificity. In this respect, the case presents puzzling questions for theories of intelligence in terms of general or interrelated factors, and theories of intelligence in terms of a composite of specific abilities.

A qualitative analysis of L.'s performances is needed if we may hope to cast some light on these questions. Therefore we have to attain a better understanding of the nature of the processes which underlie his good as well as his defective performances. In order to probe as deeply as possible into L.'s individuality, it will be necessary first to give an account of his development.

HISTORY OF THE CASE

Basis of data: Substantial information was obtained from L.'s mother, a former school teacher. Since L. became a problem child at about 2 years of age, his mother naturally was extremely concerned with all overt manifestations of his unusual personality. She made careful observations and detailed written descriptions of L.'s behavior from early infancy and at successive stages of his development. She presented him to several psychologists and psychiatrists during his 7th and 10th years, furnishing data of her own and from L.'s teachers. We compared these reports with those of the various examiners whose cooperation we gratefully acknowledge. (Drs. E. Kahn and C. C. Miles, School of Medicine, Yale University). From 1937 up to the present we ourselves studied L. at frequent intervals from his 11th to his 17th year.

The family history gives no evidence of any mental deficiency. L.'s paternal grandfather was erudite, even-tempered, and humorous. He and his wife were musical. The maternal grandfather was also a person of culture. L.'s paternal uncle is said to have a great gift for manipulating numbers, and L.'s father, a businessman, is also very quick in calculation. L.'s mother, a former school

teacher of considerable intelligence, has devoted most of her time to attempting the education of L.

Health: L. was born, an only child, December 9, 1926. His birth was an instrument case. With the exception of croup and colds, his health record was good and remained satisfactory up to the present time. In later years he suffered from hay fever, had measles, scarlet fever, and an abscessed ear.

First and Second Years: The only abnormality noticed during L.'s first year is that he kicks more with his feet than other children and makes an unusual amount of movements with his extremities, somewhat similar to those observed to date. His eating and sleeping habits are normal. He has been trained early in toilet habits and seldom relapses. At about 6 months he appropriately makes speech sounds like "dada," "mama," etc. and is considered mentally alert by his parents. His first tooth comes at 7 months. He sits up at 6 months, stands at 10 months, and walks at 15½ months. Retardation is first suspected at the age of 18 months, for he talks no more than at 6 months, and his vocabulary increases with abnormal slowness. At the same time he begins to be restless and easily frightened, and to suffer from insomnia. At the age of 2 he has a slight case of what is thought to be the grippe.

Third Year: L. shows the first signs of a remarkable interest and ability in music, rhythm, and counting. He knows the names of numerous gramophone records. He recognizes a melody if any part of it is played. He likes to count things, e.g., the stripes, or designs on the wallpaper, the keys on the piano, and many other items. He begins to develop a preference for calling off numbers quickly.

Fourth and Fifth Years: Motor coordination is poor and retarded. He cannot turn a doorknob, catch a ball, steer a baby carriage, go to the bathroom alone, ride a tricycle, or hold a knife and fork correctly. (Some of these skills improved with his sixth year, some later.) Up to the tenth year he cannot put on and take off shoes or stockings by himself.

Intellectual functions: He manifests no idea of causation. He never asks the question "Why?" He rarely offers spontaneous observations or reasons for any action or perceived event. Nor does he imitate an action of others spontaneously. He cannot make the sound of a kiss. He is unable to understand or create an imaginary situation. He does not play with toys, such as animals, or balls, nor does he show any conception of make-believe games. He cannot converse in a give-and-take use of language. He hardly ever volunteers factual information. He often fails to answer a question to the point and many times merely repeats it. He uses "you" instead of "I" and often says "yes" instead of "no."

He frequently displays laughter out of keeping with a situation which appears ludicrous to him but not to other children of the same age. On the other hand, he begins to show a robot-like associative memory in which he takes much delight. When one thing is mentioned, he will mention something which to him has become associated with it. When one thing appears, he will name another "associated" object. Therefore, observers think that he mistakes one thing for another. But to L. this seems to provide the enjoyment of playing with words, whether by association or alliteration, e.g., "blocky-locky." He will tend to say any nonsense phrase when he fails to understand what is said to him.

Social development: In the nursery school which he attends for one term, he barely notices the presence of other children, does not play with any child or participate in group activity. He is emotionally indifferent to the behavior of other children, whether they cry or whether they take away his toys (except those he is using at the moment). He will not listen to adults, except to his mother, his sole authority. She alone enjoys his full confidence and is the only person to whom emotional attachment is expressed, e.g., he cannot bear being separated from her.

Emotional development: Emotions are often intensely displayed, e.g. in tantrums when he desires something or has lost something, and often for no apparent reason. The effect however is superficial, shallow, and not lasting. Aside from his consistent love of music, and his dependency on his mother, there is little emotionality of normal depth and coherence. He does, however, develop a number of rigid fears, mostly in reaction to sounds or sudden motions which startle him during an absorbed moment. He

becomes "self-conditioned" to react with intense terror to a chiming clock, thunder, musical horns in cars, the drip of water from a faucet, the rattle of a milk cart at night, plumbing sounds, steps overhead; the sight of lightning, a cat, a dog, a bird in a cage. For a long period he awakens regularly at night, awaiting the sounds customary at this hour, and then begins his usual screaming. He outgrows these fears very gradually never going outdoors alone until the age of 12 because he fears dogs and cats. His food habits are very rigid; he is suspicious at first of anything new or strange. On the other side, distractibility, and difficulty in making him listen or care, have always been noticed and now become pronounced: restlessness, jumping up and down, peculiar movements of both hands occur at all times with apparent compulsiveness. He hardly ever stops when told to. He runs up and down in a stereotyped manner, slapping his sides, waving his hands. He grasps things indiscriminately, puts them into his mouth or holds them exaggeratedly tight in his grip.

At the same time, L.'s propensity for numbers, melodies, and rhythm increases strikingly: so does his rote memory in these fields and spelling which he enjoys. Only while spelling, counting, or listening to musical recordings does he become quiet and sometimes restful. When music is played, he will eat anything, even things he dislikes, and sleeplessness is easily banished.

Spelling: He learns the letters of the alphabet from 26 toy blocks having two letters, one on each side. He soon knows which letter is on the back if shown the front of the block. He recognizes letters when upside down (not uncommon in children). He rapidly learns to spell out from the blocks such words as "hot," "cold," "stop," "go". He has a good ear for sounds so that after spelling "go" he knows "so," "low," and "no" . . . altogether about a hundred words before the age of five.

Numbers: He knows numbers in rotation. Before his 5th birthday he enjoys counting by "skipping around." He counts by 2's, 4's, 8's, and 16's. Before his parents become aware of his preoccupation with numbers, he surprises them by counting rapidly by 16's, beginning with any number. Before he knows what any number beyond 9 "looks like", he is adding two numbers to a total above 9. He can multiply by consecutively adding the multiplicand number at an amazing speed. He always appears engrossed in some inner activity, usually discovered to be number manipulation.

Music and Rhythm: He can carry a tune. He also connects words with tunes, and taps out melodies. He frequently weeps over music. ("Eri Tu" from the "Masked Ball" and the Temple Scene from "Aida.") His memory for melodies is as accurate as his identification of the titles on gramophone records. He can tell what music is on the other side of a record being played. Before he can read, he knows nursery rhymes and verses by heart, and on what pages in books they appear. Blocks, books, and pictures appeal to him *only* for playful memorization of numerical detail.

SIXTH YEAR: L. proves to be wholly incapable of learning by instruction whereas he continues to assimilate material for fun in situations which furnish stimulation through music, rhythm, verses, numbers, letters. But he can not follow instructions to concentrate on a task; he is unable to inspect systematically, to study, memorize, or absorb material outside of those situations.

When 6:1 he enters grade school. L. neither learns nor adjusts to the classroom. According to the records "He does not respond to verbal directions. He refuses to participate in class activities, is uncooperative, unsociable, babyish, stubborn, and willfully disobedient. He likes to be annoying, interrupting and mimicking; puts his fingers in his ears in an effort not to listen, and shows many childish mannerisms. His conversation is still in the first developmental stages."

At this time a psychologist tries unsuccessfully to test L. with the Binet; L. cannot cooperate. After a term and a half, his mother follows the teachers' request to take L. out of school. Efforts to instruct him individually in writing and drawing are fruitless, although his reading ability is above the level of the class. His motor skill is retarded. (Even now he cannot hold and manipulate a pencil without difficulty.)

Intelligence tests: At 6:7, a second attempt to test him with the Binet succeeds. During the entire test at the Psychiatric Clinic of

Yale University L. moves restlessly, shows interest only in two things: (1) Tasks involving numbers and counting. (2) Riding in an elevator. The latter is used as the incentive for securing answers and accomplishment of tasks. Throughout the tests L.'s speech is hard to understand, he mumbles to himself, grimaces, exhibits his characteristic snapping movements, laughs to himself, bangs objects, or puts them into his mouth, makes absurd remarks at random.

He scores an I.Q. of 86 (Ma 5:8). *Rhythmical performances with numbers and clang-word associations are successful at the 9 year level, repetition of digits at the 10 year level.* Tasks requiring grasp of form relations are failed even after three separate attempts. He is defective in tasks requiring directed attention and organization of thinking above mental age 4. Drawings are scribbles. No written calculation can be obtained, since L. puts down numbers on paper which have no relation to the printed problem. However, his answers to corresponding tasks given verbally rate quotients of 114-129 in simple number combinations. On all formboard tests his performance rates below 5 years.

L.'s spontaneous behavior as observed in the ward reveals: He is generally absorbed in his own thoughts and activities, such as crying, shouting, laughing, waving his hands, dancing with short rhythmical steps, pounding on the wall, rolling on the floor and so on, in rapid succession. *Spontaneous speech is scant* and seems slurred, incoherent, irrelevant, sometimes being a sort of jargon which only his mother comprehends. He frequently answers questions by repeating the question or by giving a wrong answer. Certain phrases he seems to enjoy repeating over and over.

Calendar knowledge: A month before the 7th birthday it is noticed that he is keeping track of dates. On October 2, he tells his mother it is September 32nd. She explains it is a new month, and gives him a list of the months. He begins learning the names of the months, and the number of days in each month. Soon he can tell exactly on what day of the week every day of that year falls and also of the *next* year. He is now given a calendar which he loves to use. After some time, he discards it as he seems to have no further need of consulting it, except occasionally for fun. He now begins to "know" so many week-days of dates that he amazes his parents, who have to look up the calendar to check L.'s accuracy in telling the day of the week for a date of the year.

Unfortunately the parents fail to trace the actual procedure by which L. learns to tell the week-days of dates during the present and coming year. The mother does report that L. has occupied himself intensely with the list of all the months and days, also with the calendar given to him. Both parents seem to have taken it for granted that he has acquired a rote knowledge of a number of dates and week-days during his playing and that he has continued to master more and more such connections by counting from these starting points very quickly. One reason why the mother fails to inquire more closely, is that he never answers questions as to how and why. For instance, during this period he suddenly can tell how many pennies, quarters, nickels, or dimes are in 75 cents. He does this very rapidly but *cannot tell* how he does it. (He can also subtract.)

Music: He knows the melodies, texts and names of many compositions. He also gives them names of his own, e.g. "L minor Sleep" for Schubert's "Serenade." Hearing a phrase of a song, he will place it at once. He is tone-sure. First he calls the notes on the piano by *numbers,* counting them according to the position of the keys while he is playing. Hearing his mother play, he will say "You are playing the 25th note." Later he is told the names for the keys and retains them at once. He connects the names with the keys and their sound, and soon can tell what note is being played without seeing it (Absolute pitch).

SEVENTH YEAR: The identical behavioral, emotional and social abnormalities are present, only slightly diminished in frequency and intensity. According to complaints of his mother, L. is still unable to associate with other children. He is still most unreasonable, and when crossed, has temper tantrums, but he is more obedient. His speech remains retarded, the vocabulary extremely limited and the pronouns often mixed up. His reading is still a mechanical citation of printed language without grasp of content. His motor coordination shows little improvement even in simple manipulation. Despite his

mother's efforts he never writes spontaneously and must be forced to do so. Only under her influence does he begin to color some objects fairly well, to print numbers and letters.

He can sit for hours at the piano and play chords, but again it is impossible to teach him anything by instruction. He refuses to read musical scores or play from the simplest printed music.

Intelligence: At 7:7 L. is again tested by the same examiner. On the Stanford Binet he scores an IQ of 91 (M.A. 6:10). The formboard performances improve slightly. Although he reaches a quotient of 100 in word recognition, no sentences or phrases are comprehended. No words or letters are written correctly. In oral arithmetic the quotient is 96. (L. likes to give number combinations incorrectly and then wait for a response from the observer). He is curiously successful in counting objects, although appearing to proceed at random. During the six interviews with L. many rides on the elevator have to be used for motivation. Since it is possible to diminish these rides from 8 during the first two interviews to 2 in the last two, there appears to be a gradual gain in control of attention and cooperativeness. His responses are still inadequate and capricious. He runs about the room and up and down the stairs, jumping from chairs, swinging blocks of wood, pencils, etc. between thumb and forefingers with the arms held in jackknife position, all carried on perseveratively. When interrupted in a perserverative activity, L. characteristically has a small temper tantrum.

No interest can be elicited for building blocks, ball playing, or other games, but L. becomes fascinated by running water from faucets which he will observe as long as permitted while rubbing his hands together in his peculiar way.

EIGHTH YEAR: In June 1935, L., is retested with the Binet and scores an IQ of 87-102 (M.A. 7:5). His performance, as before, is uneven and unpredictable. The best responses are those which involve *rhythm and mechanical speed.* His poorest responses are to those tasks which demand comprehension, reasoning, judgement, and in which organized and planful thinking is essential. In school achievement where single-item material, e.g. word recognition or oral reading, is required, the quotients range within the average, *whereas in paragraph-meaning the quotient is below 57;* spelling however rates 92; and arithmetic computation 117.

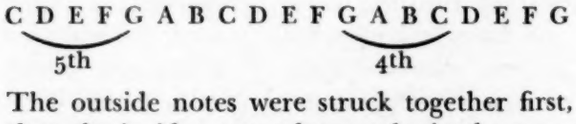
NINTH—ELEVENTH YEAR: *Skills and "socialization."* During this period L. receives a great deal of training from his mother at home and from a sympathetic school teacher at a private school. Partly by taking advantage of his propensities and partly by applying patient insistence, both get him to practice a few elementary skills and to acquire a number of new words. He begins to practice writing, to spell many words, and to develop the play-like habit of asking about the spelling of every new word he hears. He advances slightly in addition, multiplication, division, and even learns some fractions.

The mother's untiring efforts to "socialize" his conduct through deliberate conditioning methods of praise, reward, and reproof lead to demonstrable improvement. Conformity patterns appear; at the same time his social response repertoire becomes more variegated, and his temper and restlessness diminish. Significant in this respect are the comments of his school-teacher on L. at 11: "Two years ago, in order to get L. to play, I used to play hide and seek with him myself—when I hid and he found me, I would say 'boo,' and he would laugh joyously. As soon as I substituted a child in my place, he would stop playing. Learning to play with other children was a very slow process. L. paid little attention to people in general or to other pupils in school. He walked about when not at his lessons, shaking his hands and absorbed in himslef. Now he is interested in and fond of his schoolmates. Any child who is absent from school is his concern until he knows what happened. If someone is ill he inquires about him daily. Occasional visitors are greeted with friendliness; to the teacher's daughters he says good morning over and over again."

L. is now more obedient, he even manages to control his fear when the teacher brings him together with her kitten; when it gradually is brought closer to L., he eventually starts stroking a bit of its fur with one finger. Now he is no longer afraid of cats, unless they make sudden movements.

Music: Every morning as soon as his coat

is off, he will go to the piano in another schoolroom to play. An observer describes his playing as follows: "L. would play an interval of a fifth in the left hand and the same notes in the position of a fourth an octave higher, with the right hand at the same time.



The outside notes were struck together first, then the inside notes, alternately, in the manner of a slow tremolo. Sometimes the left hand would play at intervals while the right hand ran up and down the keyboard in a suitable, if not conventional, running passage. The same two or three sets of intervals were generally used." *Interestingly enough his piano passion ceases for many months when the piano is moved from the schoolroom to another room.* At home L. sits for hours at the piano, playing monotonous sequences. At this time L. develops an odd preference for playing a record from "Othello," on the gramophone, without ever getting tired of it. His mother literally can get him to do anything she wants by letting him play "Othello." This obsession lasts into his fourteenth year. L. is not interested in reading; games only interest him for sheer mechanical manipulations, although his hand coordination is little improved.

The general results of his training are still haphazard and so substandard that his mother has him examined at the New York Neurological Institute. There he is classified as an "Idiot savant" and characterized as a "mentally deficient boy, whose behavior is another expression of the organic defect." On the other hand a psychiatric consultant places him in the schizophrenic group. The positive result for L. is that he remembers the names, birthdays of doctors and dates of his visits at the Institute for months.

PERFORMANCE ANALYSIS; TESTS, EXPERIMENTS, BEHAVIORAL DATA

1. *Intelligence Tests*

As will be recalled, we found an IQ of 50 in examining L. with the Stanford Binet (1937 Rev.) at 11:3 years. A retest at 15:1 with the Stanford Binet (1934 Edit.) again yields an IQ of 48. Although the Binet scoring does not focus upon qualitative functions of intellect, we may derive from L.'s success and failure in the subtests a preliminary intelligence profile.

On the first test his basal age is IV years. Beyond this, he passes only certain tests on the V and VI year level, but none above the VI, except sentence memory at VIII and digit span at XII. Those tasks in which he succeeds on all levels tested involve:

(1) Counting and number retention (object counting; numbers; digit span)
(2) Immediate memory (3 commissions; sentence repetition; reproducing bead chain)
(3) Simple form and spatial relations (pictorial-identification, completion, likeness and difference; maze tracing)
(4) Verbal association (object-naming-definition in terms of use; opposite analogies, Year IV)

The tasks in which E. fails require:

(1) Comprehension (vocabulary; memory for stories; causal and social comprehension Year VIII; make of materials: dress, shoe)
(2) Reasoning (paper folding; verbal similarities-differences-absurdities; picture absurdities; opposite analogies, Year VII)
(3) Complex form and spatial relations (aesthetic comparison; mutilated pictures; copying of diamond and square)

The second test, four years later, at 15:1, essentially shows the same profile and accentuates the above finding. His M.A. is now 7:4 over the previous M.A. of 5:6 and his basal age is V. No tasks are solved beyond the IX year level, except digit span (8 forward—at year XVIII).

Between years V and IX L. fails as before on the identical type of tasks involving logical relations in the verbal or spatial sphere. His successes are characteristically restricted to the following tests which preeminently require associa-

tive memory, immediate retention, counting and simple visual discrimination.

Year VI	*Year VII*	*Year VIII*	*Year IX*
Knows right and left	Knows numbers of fingers on both hands.	Counts backwards 20-1	Knows dates of months
Counts 13 pennies	Describes pictures	Writes on dictation	Makes change
Knows 4 coins	Repeats 5 digits forward		Repeats 4 digits backward
Repeats sentences	Makes bow knot		Rhymes words
"Comprehends" the 2 situations (1) if it rains starting for school ("take umbrella"), (2) if house is on fire ("get the fireman")	Repats 3 digits backward		Knows months of the year
	Knows days of week		

It should be noted that this 1934 edition differs on these levels from the 1937 revision by favoring more tasks in the calendar and number sphere (9 versus 5). Consequently L. attains here a higher M.A. and I.Q. than he would have on the 1937 Revision.

2. *Language and Reasoning:*

L.'s success in verbal association and rote memory versus his failure in "reasoning" and "comprehension" calls attention to the problem of how language functions in cases of mental deficiency. Especially since object definitions, simple analogies and opposites are subsumed under the term "verbal association," one may wonder how these are divorceable from reasoning. Normally the two processes of "verbal association" and reasoning are naturally interwoven, but in abnormal cases we often find a modified use of language, a limitation to concrete, situational speech reactions and a difficulty in grasping the abstract, conceptual and symbolic meaning of language (15, 19, 21, 22, 24). The deficiency may be camouflaged by two factors: (1) the patient produces abstract words not in their abstract meaning but in the situational sense of his concrete realism; (2) associative memory for many speech automatisms which are not supported by understanding of their generic meaning and broader implications. These comments are prerequisite for evaluating adequately the analysis to follow; they should, however, not be misconstrued as a priori, and so imposed. The discrepancy between "verbal association"—success and "reasoning"—failure is one fact; what it signifies psychologically is a question of more facts.

On both Binets, L. can define only 5 words of the vocabulary test and these merely in terms of his concrete manipulation, .e.g Orange: "that I squeeze with"—Envelope: "something that I put in with"—Straw: "something I play with,"—(at 15, "I put in my mouth.")—Tap: "I tap with"—Puddle: "I put my feet in something that waters"—Gown: (at 15) "something I have on." He defines "ball" as "something that I bounce with," "stove" as "something I eat with." To the question, "Why do we have houses . . . books?", he answers, "Because they are built, because I live in houses . . . because I read books."

Thus, up to fifteen years he is unable to define the properties of objects independent of ego-centered and situational use. According to the Binet standard a child is capable of giving definitions "superior to use" in terms of objective properties or class relationship at the IX year level. (58, p. 321)

To the question "In what way are —— alike" (1) "wood and coal," he answers: "Because cables are made out of wood and coal out of the cellar." ("Wood", apparently leads to telegraph poles, and "coal" in his

thinking, comes from the cellar; both responses arise from total situations, since at 15 he replies, "Wood is up and coal is down.") (2) "ship and automobile;" A. "I sail with a ship and an automobile can run over." (3) "apple and peach," A. "I eat a peach and I eat an apple." Illustrations of this mode of thought are his answers to similarity and difference of "ocean and river." "The ocean is big, and the river is supposed to be alike with their water." Q. "Difference?" A. "They want to be big, the river wants to be big." Q. "Difference?" A. "Because the ocean is big and the river is little."

At 15, he defines the difference between: (1) "fly and butterfly?" "Fly flies in the air, butterfly goes down." (2) "Stone and egg?" "I eat an egg and I throw a stone." (3) "Wood and glass?" "Glass I break sometimes and wood is a thing people pick up."

He is incapable of comprehending more than the most superficial relations represented in Binet pictures. To all picture absurdities L. simply responds with enumerative description, e.g., to the man with umbrella in a wrong position during rain, he says, "Yes, the man is holding an unbrella, I don't know why, there is a lot of rain there."

Aside from the fact that L. can neither grasp nor formulate similarities, differences, or absurdities, these tests demonstrate also how L.'s language reflects his handicap to reason abstractly. He evinces two types of speech: (1) highly egocentered, pertaining either to action, situations, or subjective emotional experience (which has been demonstrated in the above examples) (2) automatic, stereotyped, associative. This is demonstrated by the following facts.

He uses words picked up without understanding to a degree abnormal even for children; he will not spontaneously admit failure to understand their meaning. On the word-naming test, he produces 35 words in 2 minutes (28 are reguired in one minute). Subsequent inquiry, however, reveals lack of grasping their meaning. His verbiage includes such words as "rheumatism" which he explains as "big, big doorknob," "yard" which he defines as "backyard," "battle" for which he offers, "I won the battle". Q. "What is a battle?" A. "I don't know."

To the question, how penny and quarter are similar and different, he answers "because the penny is big and the quarter is small, because they are different in shape, the penny is down and the quarter is up, high." Q. "In what respect?" A. *In a good respect.* The only reason for this response is the association between the words "respect" and "good" which he had heard previously without understanding. In this way he has acquired a repertoire of words, phrases, and mannerisms which he applies without discrimination. It appears that through these verbal mechanisms, he often disguises his incapacity to account for his answers or actions, his lack of insight into the social relations, into the sense of questions that confront him. To the "verbal absurdity" of the man who was found murdered after he has locked himself in the room, he replies, "He didn't lock himself in." Q. "Why?" A. "Because you told me so, because Dr. G. told me so, because you're supposed to be a good man." This is not a singular instance because for some time he answered the question "why?" with "Dr. G. knows" or "Dr. S. knows" or "Dr. G. . . ." or "Dr. S. . . ." or "You told me so", or "I know that's right" or "Everybody knows" or "Nobody knows." To the question, "Are you sure?" he is likely to reply, "Everybody is sure." If he does a test badly, e.g., an unrecognizable drawing from memory, and is confronted with the original, he will laugh and say, "Yes, that's right, I know that's right." When asked whether he knows the answer to something, he says "Yes," but when asked if he can give it, he rattles off "I don't know" or "No, nobody could." Obviously he does not understand the causal sense of the question "Why" nor does he raise that question himself.

Of the *Vigotsky blocks,* (23) he groups together a white and blue cylinder. Asked why he has grouped them so, he cannot answer. Q. "Are they the same?" A. "Yes." Q. "Why?" A. "Because the blue and the white are the

same." Asked why they are the same, he replies, "There is no question why." This and other speech clichés easily become a mannerism with him whenever he is at a loss. He is asked "What time of the year is it?" A. "Lunchtime; daylight saving time." Q. "What does it mean?" A. "April Fool. It means to be good, always to be better." Q. "What does 'to save' mean?" A. "Daylight saving time." Q. "How many words has it?" A. "Four words." Q. "What does 'saving' mean?" A. "Nobody knows." Upon further prompting, L. finally says, "Don't eat the chocolate; save it means being good."

The above-mentioned expressions, seemingly implying *generalization*, conceptual meanings, are patently conditioned verbal responses for L., since he reproduces them without real sense. Their only sense might lie in the relief gained by coping with an unanswerable question through automatically rattling off linguistic associations. Although his mother tried to train L. by rote in the spelling of homonyms and although he could distinguish between "two," "too," and "to," "deer" and "dear," the following incident is instructive: Once Dr. R. said, "Goodbye, my son." and L. replied, "I am not your son." Evidently he is unable to conceive of the metaphorical meaning of such a phrase. This is further amplified by his failure to apprehend the general content of words or to discern a common denominator of objects, e.g., he cannot grasp what words "belong together," what "group," and "heap" mean, even if demonstrated to him. Although he is not colorblind, he cannot verbalize what a group of like colors presented to him, have in common, just as he could not explain why he reacted to the congruent shapes of the Vigotsky blocks.

On the simple color-sorting test with Holmgren skeins, (15.22) he cannot sort a number of skeins of the same hue, e.g., green or red. Prompted, he only groups the dark-red skeins, excluding any light reds, all of which he calls "pink." Of the green, he includes some light greens, rejecting the rest. He never puts the selected skeins in a heap, as most normal persons, but places them one beside the other in a row. Characteristically, his *first* response to the task is that he starts *counting* the skeins. Correspondingly, he places, in the G.G.W.S. object sorting test, (15.22) the following objects in a row: (1) toy hammer, (2) toy spoon, (3) toy fork, (4) nail-in-wood, (5) big fork, (6) big knife, (7) screw-driver. Q. "Is this a group?" A. "No, this is seven."

After manipulating the above objects, he is asked, "Show me the longest . . . the shortest." He does not understand the words "short" or "long." His mother attests that he only grasps the words big and small, (or little) referring to objects. Genetically this indicates a stage of diffuse thinking in which the global impression "Big" . . . "Small" has not yet become differentiated into the sub-aspects: length and shortness of *either* "big" or "small." His lack of abstract thinking is again manifested by his success on two opposite analogies, Binet year IV and his failure on two others at year VII. L. succeeds on: brother is a boy; sister a—("girl") and on: a table is made of wood; a window of—("glass"). But he fails on: the point of a cane is blunt; the point of a knife is—("hurts") and: an inch is short; a mile is—("good"). Where his associative speech memory could be utilized, L. "solved" the analogy. Where this memory is of no avail and relational reasoning is required, he fails typically by either resorting to speech clichés or by relapsing into a concrete situational mode of thought.

To study this problem in a more crucial form, a specially devised analogies

test was administered in typewritten form. The results in the following record strikingly illustrate the associative type of his verbal "reasoning," as well as his restriction to the concrete; at the same time, the possible pitfalls of testing without qualitative analysis are pointed up. (The tasks were given in a mixed order and are here classified together for the sake of simplicity.)

I. *Unsolved Analogies*

			Answer
water	drink	air	—
lamp	oil	stove	—
potato	vegetable	veal	—
bread	flour	candy	—
sight	blind	hearing	—
air	birds	water	—
complex	difficult	simple	—
month	week	day (He asks, "What is a day?")	
present	known	future	—

II. *Correct Solutions*

			Answer
birds	fly	fish	swim
light	day	dark	night
sun	shines	wind	blows
food	eat	book	read
slipper	shoe	cap	hat
water	glass	coffee	cup
happy	laugh	sad	cry
man	husband	woman	wife
clothes	tear	dishes	break

III. *Incorrect Solutions*

			Answer
hat	head	shoe	boy
barn	hay	library	stamps
father	son	mother	girl
cup	saucer	knife	plate
far	near	there	office
mail	write	telephone	receiver
cats	scratch	bees	fly
hair	black	eyes	blue

Analysis of this protocol shows:

a. L. does not complete analogies which involve causal relationships (lamp, oil; stove—), analogies involving the superordinate or the subordinate concept (bread, flour; candy—; months, week; day—), or analogies of congruent meaning (sight, blind; hearing,—; air, birds; water—).

b. This suggests that the correct solutions have been obtained by situational thinking or associative memory, and not through understanding of the logical relations implied.

c. The wrong answers also point to associative, stereotypes (cats-scratch, bees-"fly"; mail-write, telephone-"receiver") and to concrete realism (cup-saucer, knife-"plate"; hat-head, shoe-"boy"; far-near, there-"office").

d. The records of the correct and incorrect solutions taken together indicate that L. adds his answer to the last printed word without actually having reasoned out the relation between the first two words. His response is not the discovery of a word that expresses an analogy and carries over the rationale as implied in one word pair to another one. His response fills a gap in a situation

which the preceding words have awakened in him; it may complete the concrete situational meaning which these words suggest to him, e.g. birds-fly, fish-"swim"; happy-laugh, sad-"cry"; clothes-tear, dishes-"break"; cup-saucer, knife-"plate"; far-near, there-"office", etc. Or his answer fits more associatively to the last presented word, e.g. telephone-"receiver;" bees-"fly"; wind-"blows", etc. For this reason there is no qualitative difference between the psychological processes operative in L.'s correct and incorrect solutions. This corresponds to his responses on the Binet analogies: brother is a boy, sister is a—"girl"; the point of a cane is blunt, the knife is—"hurts".

e. There is however a difference between the given answers, wrong or right, and the unanswered analogies mixed in. Why L. refrains from answering these we could not determine, but may offer this observation: if one, without reasoning about the analogy, reads the three words together, one may be stupefied. The three words do not fit readily together in a concrete, situational sense, without imaginative effort, e.g. water-drink, air—, bread, flour, candy—. Air-birds, water—. Other words are rather abstract as e.g. sight, difficult, future. These as well as the words vegetable, veal, oil may have been outside of L.'s routine and therefore blocked situational or associative memory.

3. *Language and Social Understanding:*

On the psychological basis of these two types of speech mechanisms, apparent inconsistencies in L.'s verbal performances become understandable. At 15 he can call out a word that rhymes with "day," "mill," "spring," the examiner first giving an example himself. In contrast, L. is unable to understand the problem of making up a sentence of three words ("boy, river, ball";—work, men, money"). Evidently the inability adequately to register and absorb human relations and social facts coincides here with L.'s impairment in the sphere of verbal meaning, where he can neither comprehend nor create complex symbolic relations. This may explain and reconcile other discrepancies in his verbal achievements. At 15 he answers, "I call the fireman" when asked what to do when the house is on fire . . . and "I take an umbrella" when asked what to do if it rains starting to school. Whereas here situational speech associations may usher in the correct response, the very same processes bring about an inadequate response when the question involves the reasoning out of the essential referent of a word or of an imaginary problem situation: he promptly calls out "Board of Health" when asked "What is Health?", and to the question, "What would happen if you shot a person?" he replies, "He goes to the hospital." Correspondingly, he solves the two problems thus: (1) "What's the thing for you to do, when you notice on your way to school that you are in danger of being tardy?"—"Go to school" (2) " . . . if a playmate hits you without meaning to do it?"—"Hit him back."

Such results have to be considered together with the mentioned fact that L. shows an astounding memory for many words and phrases. He gives the impression that he is *compelled* to utter these, operating like a stimulus-response mechanism (hearing a phonetic sequence,—executing it motorically—connecting both responses with a situation—repeating the response when the same or a similar situation occurs). For example, Dr. G. said to him, "Boy." L. seemed to

dislike it, replying "I am L., not boy." When several weeks later, Dr. G. greeted him with "How are you, L.?" He answered, "You called me boy." He reproduces conventional phrases like a well-conditioned automaton with an empty expression on his face which is sometimes enlivened by a silly smile. Upon entering the room, he is likely to say, "How are you Dr. G."; "how is Mrs. R."; "How is Dr. S."; "Nice day to you". When leaving the room, he will say, "Goodbye; give me a kiss" to everybody in the room, even complete strangers, like a conditioned robot without discrimination. He does this in a parrot-like, automatic manner without the appropriate expressive gestures, and without actually waiting for an answer or a kiss. His impersonal friendly politeness seems to be the product of his mother's efforts to socialize him without his grasping the propriety of these verbal responses.

Linguistic rote memory without comprehension of social contents and symbols may operate astoundingly well and thereby mask the real defect. This is dramatically illustrated by an examination record at 14:6, after L. had been attending the G. . . . School for several months. In class he had had to memorize the Gettysburg address. Faultlessly and in toto he recites it to us by heart. We ask him to tell it in his own words, or any part of it. He is completely stumped and could not produce a single phrase. Q. "Who was Lincoln?" A. "He was the man who was born in 1809. He died in 1866." In the class a book on Lincoln had been studied for weeks. Q. "What was the book on Lincoln about?" A. "The book was about Abe and Sally." Q. "Who was Lincoln?" A. "Lincoln was the 16th President; Hoover was the 31st President." Q. What is a president?" A. "I don't know." Q. "Is it a long time that Lincoln has been dead?" A. "In 1937 it was 72 years ago." (mistake of 1 year). Q. "Is it a long time?" He cannot answer, but knows the terms of office of all Presidents by heart.

He had recently attended some movies. Q. "What was The Great Dictator about?" A. "It was about an airplane and a tank." Q. "What was John Doe about?" A. "About a church bell." No other responses can be elicited. In striking contrast to his memory for the names and dates of individuals, he cannot recall the name of a single movie actor.

From the above protocols we only get hints of the full consequences of such a deficit in symbolic reasoning for L.'s social and world orientation. Here, the "inner logic" of the case itself sometimes takes the examiner by surprise.

When L. is 13 Mr. J. Dunninger volunteers to hypnotize L. during our attempts to uncover his calendar procedure. As usual L. is at first aloof and inattentive. Mr. Dunninger whose skill as a magician has since become radio legend, tries to establish rapport with L. by tricks, making handkerchiefs and similar objects disappear before L.'s eyes and reappear in odd places. L. remains unimpressed to the degree of boredom. Finally, it dawns upon us that L. could not possibly *"wonder about any event,"* because any idea of cause and effect was out of his reach. Correspondingly, it is an unexpected discovery that L. is unable to tell who was the older and the younger of two persons confronting him, even when a great age discrepancy was conspicuously present, and this in the face of L.'s just having figured out the week-days of their respective birthdays.

4. *Social and Emotional Adjustment*

Within this framework, the development of his responses to social demands of the "normal milieu" are enlightening, especially during the years 11-15. Whereas up to 11 he was unskillful, entirely dependent, and not amenable,

he gradually begins to do punctiliously everything his mother tells him, e.g. on leaving the house his mother instructs him to take a glass of milk and three cookies in an hour; the observer reports that L. fulfills the instruction to the letter. When offered some chocolate in the afternoon on another occasion, he answers, "No chocolate. Dinner soon." In contrast, before 11 years, if L. saw or was promised some chocolate he would ask or reach for it in a completely uncontrolled manner, and, in spite of his rigorous training and good manners, would forget to say thank you.

Now he acquires self-discipline, undresses and dresses himself, can go alone to the store and make purchases as directed, but if he must make a choice, he looks disturbed, embarrassed, and seems at a loss. Similarly, when he answers the telephone, he will take a message if told beforehand that a person will call, but if faced with a novel situation demanding a decision, he is again at a loss. It is unfeasible to give him two different instructions and leave the choice to him. At 15:2, placed in a hospital he is told by his mother that he will stay there for two weeks. Seven days later he is told that he will leave for home. He replies, "You must ask mother. She said two weeks."

This sort of rigidity, difficulty to shift, well-known in cortical cases, (17,18,22), is expressed in many more ways. L. never takes the initiative, except in his delineated interest spheres; apparently he does nothing with his time when left alone; reads or writes only if coerced, and then poorly, e.g. never gets the essential of a story in a primer but reproduces only random facts. He is very pedantic in his bed ceremony, even shoe laces must be in a definite place. On the other hand, he has no shame to parade naked through the house. His mother is convinced he would proceed outdoors that way. He has to be trained, praised and reproved for neatness and appearance, e.g. button closing, and wearing his sweater the right way around. This rigid, and at the same time socially unimaginative behavior, is characterized by his mother as "neat without a sense of neatness." Psychologically speaking, L. has to be conditioned stepwise in all those habits which a normal child is free to adopt through social insight, after earlier conditioning has become extinct or obsolete.

He is still hyper-kinetic, especially if left to himself. Often he talks to himself, laughs without cause, goes into silliness. On the other hand there is an increased need for approbation. Therefore he is more strongly motivated to listen and to pay attention when presented with a new task. Characteristically his first reaction to anything new is always, "I can't." ("catastrophic reaction.") Tears come at once when he experiences failure, and relief sets in when he succeeds or is praised. In this way he can be taught at 13 to write words on the typewriter, at 14 to swim and at 15 to ride a bicycle—always of course requiring a multiple of the normal learning period.

He plays with other children on the street, but he dislikes it because they don't understand him. He becomes fond of some people, talks of them chiefly in terms of how many days it has been since he has seen them (even if more than 100 days have elapsed.). At the same time, however, his emotional responses and human attachments remain shallow and perfunctory. Meeting him at intervals of several months, one is welcomed and bid goodbye with the same impersonal kindness as if contact were only real as long as it lasted during

concrete presence. Also then, it is a presence without emotional content. In this connection other emotional reactions are of interest. He may develop fears just as he did as a child. When his first EEG is taken at 12, alcohol gets into his eyes, and since then he becomes frightened by alcohol in any context. During his second uneventful EEG he becomes interested in the word and after a few repeated spellings he remembers it correctly for a long time.

During his 13th year the Rorschach test is administered. The interpretation in blind analysis is summed up by the expert as follows:

"In the test is conspicuous a complete lack of any tendency to see figures or animals in action which indicates that there is no spontaneity present in his mental activities. He has no imagination whatsoever; shows an obvious inability for any form of abstract thinking, for getting the main characteristics of a given body of parts, or for establishing connections or combinations. This inability stands in striking contrast to an occasional sign of sensitivity or even originality in seeing certain things. This occasional toeing the mark seems to be casual and unpredictable. His reaction to emotional stimuli coming from without appears to be particularly shallow and flighty. There seems to be a complete lack of control in logical thinking. Within a generally very poor selection of contents which represents high stereotypy of his mental life, we find a few peculiar original selections, as airplane in card 1 and cookie in card 6, the green in card 7, indicating that his mind is capable of occasionally picking up things outside of his main line of thought."

5. *Organization of Visual Responses—Retention and Imagery: Visualization of Spatial Relationships*

In view of L.'s number and calendar manipulation it seemed advisable to investigate his visual performance range. Since many "lightning" calculators possess eidetic imagery, L. was tested for this function as well. With chocolate as the inducement for getting sufficiently enduring attention we performed the following experiments:

(1) Presentation of *black-white pictures* for inspection, analogous to E. Jaensch's procedure. After removal L. shows less visual retention of pictorial items than normal children.

(2) Tachistoscopic presentation of simple dot figures; nonsense syllables with 5-6 letters; familiar words. Each slide was exposed for 1/10″, ½″ and 1″ in various randomized trials. L. is instructed to copy what he sees during and immediately following exposure. No dexterity factor is involved in this task as ascertained by control experiments without short exposures. L. cannot adequately apperceive nor visually retain dot figures, words like "address," "instead," "because," "therefore," though cooperation is high, as counting and spelling appeals to him. These findings speak against eidetic imagery and for a subnormal span of visual apprehension.

(3) Presentation of E.S.P. cards; (a) 15 E.S.P. cards are exposed for 30 seconds. L. is asked to name the 5 different patterns present, which he does. Questioned after removal, "How many different pictures did we have," he enumerates 4, omitting one. (b) L. inspects for 30 seconds a row of 6 cards, e.g, star, cross, circle, waves, square, cross. After removal L. cannot reproduce the correct sequence from memory, failing likewise on other series of 6 cards. But when instructed to name the pictures in their sequence during his inspection, he faultlessly recalls the presented series upon removal. This suggests that L. does not succeed on the basis of visual memory, i.e. by reproducing optic contents, but by repeating phonetic contents on the basis of speech memory. Thus asked to repeat verbally a series he has just called out from memory, he succeeds without hesitation.

(4) Woodworth and Wells Visual substitution test; L. places the required number into the respective figure by looking up the sample figure each time containing that number. He obviously cannot retain visually the 5 numbers and figures that go together. "Simultaneous" attention to the task-figures and fill-in numbers is so difficult for him,

that he discontinues in the middle of the page.

(5) Army Beta Cube Counting Test; L. counts correctly the number of those cubes that are present to direct view, but fails completely on those which are concealed. On the more complex cube constructions he begins to count the squares, without visualizing the cubes at all.

(6) Visual Planning; (a) Maze tracing; (b) Ball and Field test; (c) Watch drawing.

(a) Of the Binet. L. solves 2 maze tasks on the VI year level, of the Beta he solves the 2 simplest of 5. Qualitatively his performance is here better organized, probably because his successful orientation in the simple mazes is guided by the pattern as concretely outlined; since this involves more passive tracing than active visualization, he follows the path, but crosses the boundary lines rather often.

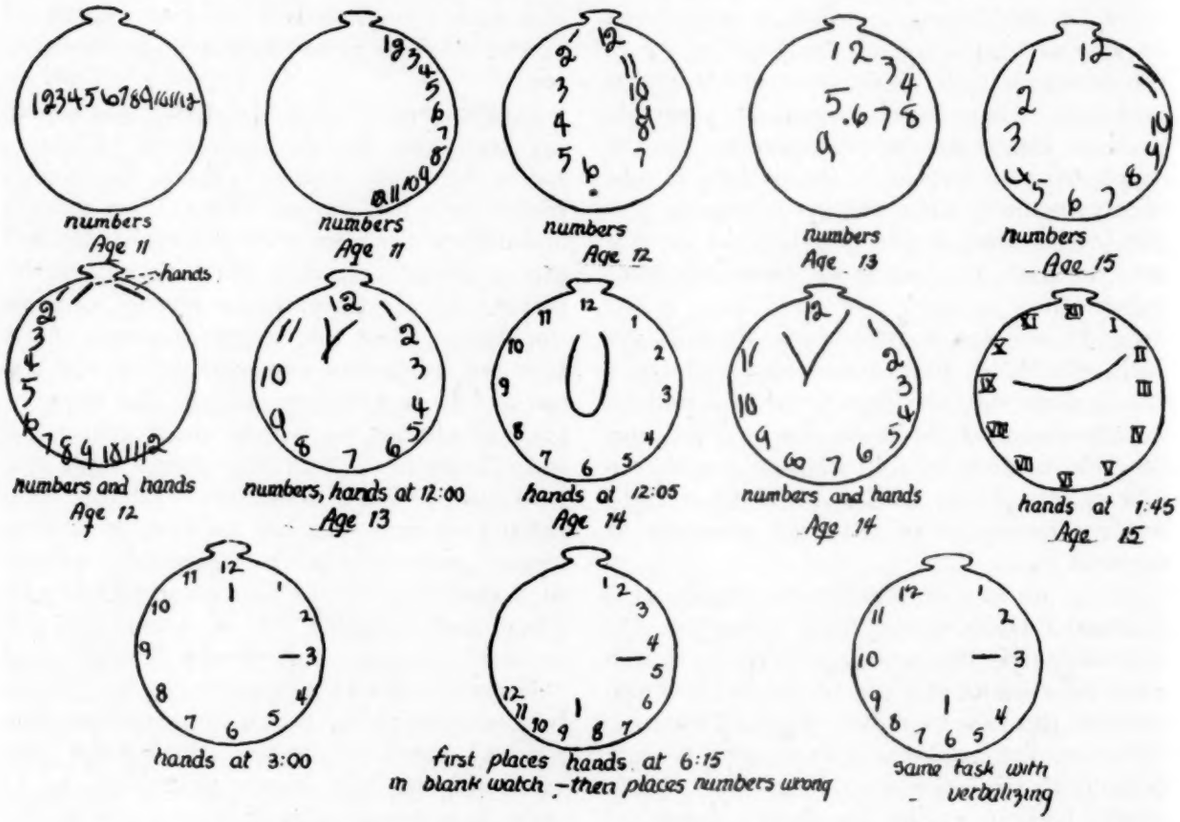
(b) In contrast to the above he fails signally where he has to conceive actively a visual plan, e.g. the search for the ball in the circular field. At 12 he simply duplicates the field outline by following its inner contour closely. At 15 he draws a short straight line in the center of the field, pointing to the exit.

(c) At 11 L. can arrange the hands of a cardboard clock at the hour requested. He also recognizes the outline of a drawn watch and understands, if asked to put in the numbers for the hours in their places. However, he writes the numbers 1 to 12 simply in a horizontal sequence across the face of the watch, without caring for their proper positions. Four years later he has improved slightly on this performance. Now he places the digits along the circumference of the watch. But he either fills only half of the circle, beginning with 1 and terminating with 12 at "6 o'clock," or he arranges the digits in reverse order from 1 on, counterclockwise, or makes other spatial errors. Whenever asked to draw the hands also, so that they show a certain hour, he makes two short comma-like strokes at the correct places, but never connects these strokes with the center, at best connecting them by a curved line across the face or across the segment closest to the strokes. Told to place the hands at 6:15 within the outline drawing of a watch containing no hour numbers, he makes 2 short strokes at the approximate places; but if then asked to put in all the hour-numbers, he errs so that the numbers do not fit to the positions of the hands. The same task is repeated with the instruction to speak aloud while doing it, and this results in greater accuracy. Never does L. begin with 12 in filling in the numbers, but always with 1, no matter how adequately he performs. These performances suggest that L. reproduces the digit sequence on the watch by drawing upon other psychological function than visual, namely the rote *knowledge of the number series through speech memory.*

(7) Imagery tests; (a) L. shall draw a map of any room in his apartment; of the 3 rooms where the testing is done. He is completely at a loss though he has been moving about these premises time and again. Neither can he identify on a drawn map any of the rooms; (b) He goes to the wrong room of the above 3 when told to get something there. It seems he cannot visualize the spatial layout. (c) L. is asked to describe the color of hair, of clothes, or of any other feature of individuals he is well acquainted with and who just left the room after having been talking to him. He has no idea how they looked and, even when prompted, confuses such characteristics as hair color and height, ("big" and "small"). Yet he knows the difference between the words "blond" and "brunette". (d) Correspondingly he errs or fails in discovering the missing parts on mutilated pictures of the Binet and Army Beta tests, showing no improvement up to 15 years. It is noteworthy that on 4 profile pictures L. indicates as missing those features which are not omitted from the drawing but only once represented, for instance where one of the ears, eyes, nostrils is visible and the other concealed by the pose of the head. Thus on a left ¾ face without mouth, L. reports as missing: "The body, the left ear, left nostril,"—not mentioning the mouth and confusing left and right. It would be erroneous to assume that L. gives these responses to a profile because it evokes in him the visual images of both sides of a face which the actual drawing does not match. On the contrary, L. does not even seem to realize the difference between a profile and a full face; therefore, he interprets the presented profile concretely as an incomplete face. In seeing a profile-drawing we normally

visualize it as a whole face, turned half to the side, and would not denote its unexposed side as missing. Because L. cannot visualize a profile as a whole face half-turned, he sees the profile as a full face which is incomplete, in which symmetrically corresponding features seem missing; and, because of his poor visual imagery, he confuses left and right. or imagining things absent and of representing to himself spatial relations. Upon closer examination these findings prove to be not restricted to visualization as an isolated function per se. Additional experiments reported below demonstrate that corresponding to his reduced span of

PLACEMENT OF HOURS AND HANDS IN WATCH OUTLINES



(The last three drawings are reproduced schematically)

Furthermore, his difficulty in analyzing visually the given percept leads him to miss up on the missing mouth and to interpret the instruction in such literal sense that he speaks of a body as missing. This "realistic" response, correct as it were, resolves the task on a rather infantile level of verbal concretism and Gestalt completion, but not through accurate visualization, the normal process at his chronological age.

Analysis of L.'s responses in Experiments 1-7 suggests that L.'s visualization and optic imagery are subnormal. He seems incapable of volitionally retaining apprehension L. is limited to a primitive organization in his optic contact with objects. His visual grasp lacks differentiation as well as the power of directed observation.

(8) Figure-ground articulation. (a) Looking at the Rubin vase-profile figure he cannot make anything out of it. Using the Harrower method (25) of enhancing stepwise the vase or the profile character by adding details to either, we can eventually induce recognition of the profile or the vase. Presented again with the ambiguous figure, however, he is again at a loss. (b) When first shown a draw-

ing of a star he calls it a cross and does not admit a difference when confronted with a correct drawing of it. He gradually learns that distinction. (c) When first presented with a cardboard clock and asked to tell the time L. can only do it when the minute hand is placed at 5, 10, 15 minutes and so forth, but fails when it is placed anywhere between the full 5 minute intervals. Thus he can read 3:05 but not 3:08 etc. According to the National Intelligence Test, this lack in differentiation should be outgrown by the sixth year.

(9) Pictorial identification. L. is to find a familiar object on a Binet picture. Inevitably he will first point to any object nearest to him and succeed only after repeated prompting. Apparently he has difficulty in surveying the entire picture as one configuration and in analyzing it at the same time.

(10) Aesthetic comparison. For the same reason his choice of the "ugly" or "pretty" face is wholly inconsistent when confronted with several pairs of such faces. Closer observation reveals that he never compares the two faces but simply looks at the one that strikes him first. The two performances of optically surveying two different objects together and of comparing both are beyond him.

(11) Visual recognition. L.'s handicap in optic structuralization and imagery also affects his ability to integrate past experiences with a present visual experience. On the Healy completion test two football-playing boys are to L. "two boys marching, shaking hands." At 12:6 he describes a full-page picture in *Life,* presenting a track star: "There is a man, his leg is in front of the other leg, I think he is running a little." Giving the content of another picture, he calls soldiers, "firemen," and the upright cannon shells which they carry to a big gun "candles." (His first reaction is, "There are 5 men in the picture.")

6. *Visuo-Motor Organization*

L.'s deficiency in visualization characteristically manifests itself also in those performances which involve the translation of conceived optic relations into motor construction.

(1) The manikin test. At 12 L. fits both legs into both shoulders, placing them parallel to the trunk and one arm adjacent to each leg again parallel. After demonstration of the correct placements, L. fits the arms appropriately, but puts the legs feet up into the trunk. The 2 arms were however not fitted in accordance with the respectively round and angular openings of each shoulder. Shown the proper arrangement and queried as to what the "whole thing looks like", L. first enumerates "a foot; and a hand; buttons, ear, and a mouth." After a pause he adds: "A man." Manifestly up to this point he had not conceived of the various parts he manipulated as "members" of a whole belonging to the figure of a man.

(2) Mare and foal; two figure form board; feature profile test. L.'s procedure is haphazard and random. Even where he finds a piece that fits he promptly gives up, taking the piece out, if he cannot push it into the opening at once. Likewise, when he happens to match a piece correctly, but fits it obliquely to the corresponding contour, he gives up instead of adjusting its position. Obviously he does not grasp the required form relationships, and therefore depends upon blind trial and error without any regard for form adequacy or meaning of parts in the whole. He often piles other pieces upon an obviously misfitted piece, not being concerned about physical obstruction of the first piece to these additions. Correspondingly he places all parts of the feature profile on top of the face, e.g. sub-structures of the nose on the square-opening for the ear. Eventually he matches the profile parts to the face contour leaving the ear empty. Asked what the whole looks like, L. does not recognize it as a profile until the experimenter points out his profile to him for comparison.

(3) Block construction. At 15 L. reaches only the five year level on the Merrill Palmer Puzzle and Delcroly Tests, and the four year level on block construction from model. On the Goldstein-Scheerer Cube Test (22) L. never fails in the choice of the correct colors on the blocks. However, he fails on all designs where complex patterns have to be organized, especially where the use of one-color sides is no longer feasible. He is usually not helped by presenting him with the enlarged design of the model, which equals the area of the four blocks, whereas the lined design enables him at times to succeed. But

when presented with the unlined original design immediately thereafter, he fails again, often repeating the identical mistakes. His main errors consist in simply arranging the block colors in space corresponding to the color sequence on the model without regard to its pattern, as if "telling a story in color" by enumeration. His difficulty belongs to the type described by Goldstein and Scheerer (22) in which the patient seeks to reproduce his color impressions without being able to grasp their figural relationship as parts in a pattern. This concrete response to different colors in space leads L. to reproduce the design by a global matching of the block sides to his color impressions, e.g. "there is red and there is yellow." This he often expresses verbally while manipulating the blocks. In this way he sometimes succeeds in obtaining a correct matching. When he fails however, he does not make an attempt to change his approach; he can either perform by concrete matching or not at all. For the same reason he cannot learn from his success with the lined design and transfer to the original design.

This lack of transfer may be caused by the difficulty in abstracting the visual form from the given model L. faces at the time. He frequently does not recognize that a presented block model is *identical* with the enlarged design on the card.

(4) (a) Copying and Drawing; (b) Writing. (a) On the Goldstein-Scheerer stick test (22) L. has to copy from memory, after 10" exposure, simple outline figures such as a square open on the left side, an underlined circle, a horizontal arrow, spade, a standing elipse, etc. He uniformly changes the positions from horizontal to vertical in his reproduction. Here a tendency toward simpler "gestalt" formation in terms of symmetry is apparent. (b) This trend is unmistakable in all his drawings up to date. He practically never achieves a correct copy, either from direct presentation or immediate memory.

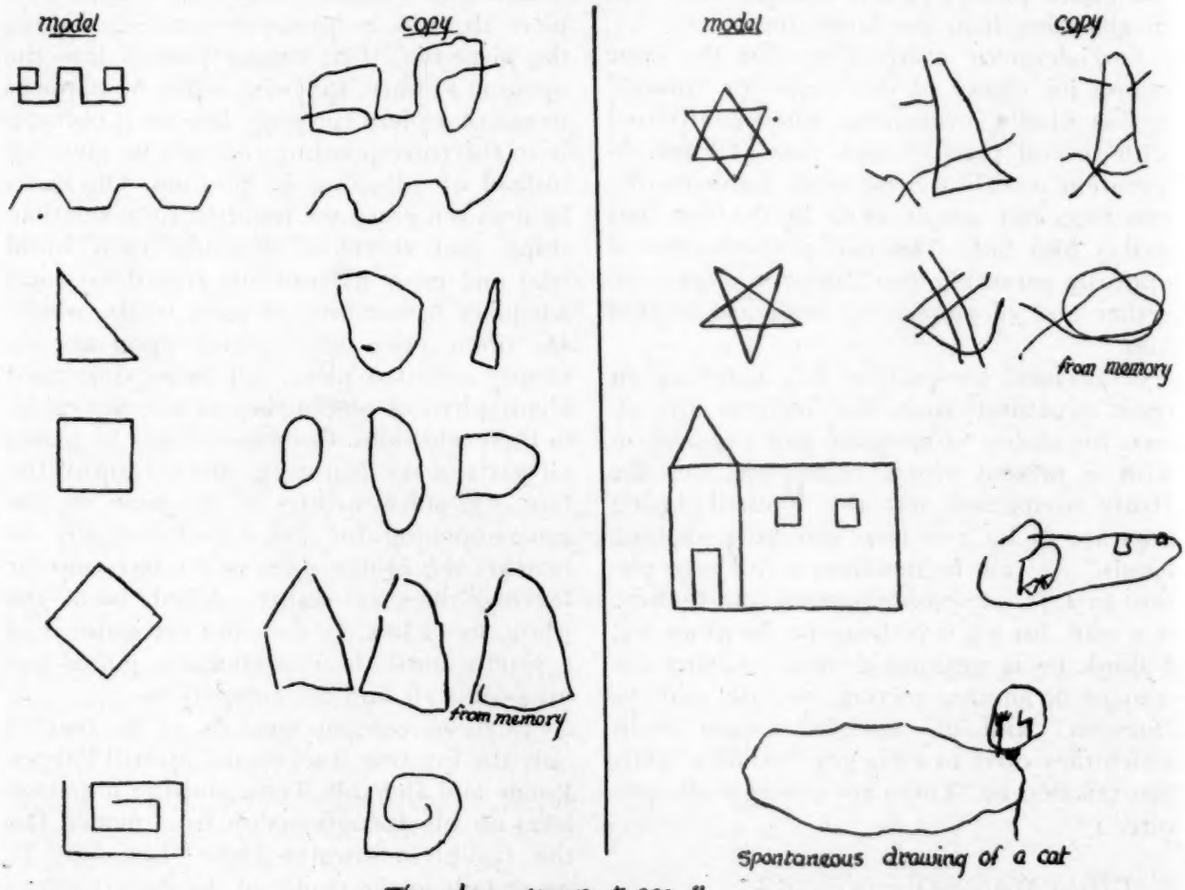
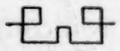


Fig. 2

His outstanding deviation is a tendency toward rounding out the corners of any figure he copies; e.g. he draws a square, a diamond, or the figure  on the Binet, curved instead of angular, the square circular, the diamond oval, and the triangle pear-shaped. This tendency appears to be rooted in a lack of differentiation in visual and motor performance. A star such as this  will either be copied by curved lines crossing each other or by a "rounded triangle" with spikes. His mother taught him to draw such a star without lifting his hand from the paper and he improved by kinesthetically reproducing the crude form of the movement so that the drawing became a scribble in spiral form, but he never learned to draw a real star (See Figures 2 and 3).

(c) His writing is very poor in shape articulation. He has particular difficulty in maintaining the individual letters on a horizontal line. He can, however, write with his left as well as with his right hand, and forward and backward, which indicates some kinesthetic imagery in his learning.

many more rehearsals. One year later, at 12, he is asked to repeat the performance and answers, "I have forgotten how to do it," which proves true.

7. *Serial Performances, Cube Tapping, Counting, Spelling*

Certain experiments seem to indicate that L. resorts to speech mechanisms for support in visuo-motor tasks, e.g. in the E.S.P. retention, in pictorial understanding, in the placement of the hours on the watch, in the Kohs block, etc. In particular, it appears that he lapses into a verbal, enumerating procedure, as the easiest substitute in coping with such tasks. In the experiments to follow, we have studied these coping mechanisms which seem to be rooted in his particular aptitude to master verbal or numerical sequences in stepwise succession quickly and to remember them easily.

(1) Knox cube test. L. not only makes the highest score of 6 steps from memory in

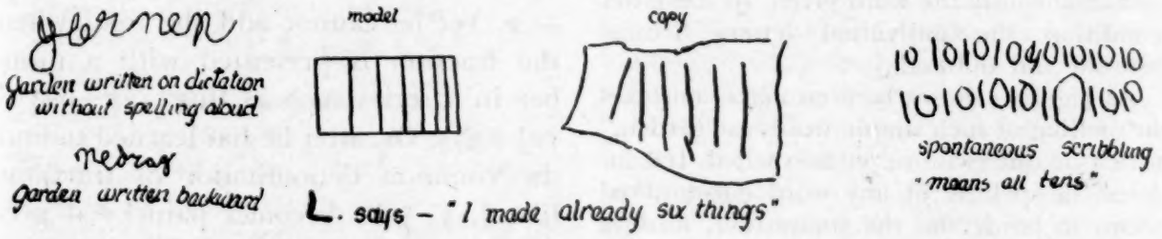


Fig. 3

(5) Manipulation; L.'s already described motor retardation is particularly striking in such complex tasks as lighting a match and a candle or blowing them out. At first he can do neither, and exclaims after demonstration, "I cannot do it." Repeatedly being shown how to strike a match and to light a candle with it, he begins to strike the match on the cardboard instead of on the sandpaper. Reinstructed, he grasps the match so close to the inflammable end that he has to be corrected in order not to burn himself. Finally he holds the burning match, helplessly regarding the candle. Even now he does not connect the various acts in their proper causal sequence, learning this only after the tapping sequence, but also doubles the number of this required maximum in a complicated series which we added to the standard procedure. The apparent contradiction that L. could not tie his shoes, catch or throw a ball adequately before 10, etc., but on the other hand learned to typewrite, may be explicable in terms of his good mechanical grasp of serial acts of simple structure. (2) Correspondingly he is able to solve all tasks on the *Army Beta* which involve the completion of XO series and makes no error on the number series identification task. It is noteworthy that in the above problems L. accompanies his solution with verbalization of the steps required, as attested by

various experimenters on different occasions. Moreover, if prevented from speaking while he completes a geometric progression he will fail. Usually after having finished a part of such series, he will begin it again and has to be redirected. These behaviors make it doubtful whether L. really understands the principle involved or simply continues to count in the same step intervals as the incipient series suggests while he reads or copies it. *(3)* In contrast to the inarticulateness and poor direction in his handwriting, L. can *spell* in writing correctly a great number of words, forward and backward, and this, amazingly, with either hand. He can, however, spell aloud quickly forward and backward without any visual help; he uses phonetic spelling whenever he hears a new word and eagerly learns the correct version. At 11 he usually spells aloud before or while he writes a word down upon dictation. These facts strongly argue for the conclusion that his spelling is centered in auditory-motor processes. A further case in point is the difference in his products when he spells a word out loud while writing it and when he is compelled to write silently upon dictation with the instruction to write down instantaneously the word given. In the latter condition the individual letters become blurred and diffused.

As Figure 3 shows, he even makes mistakes in spelling of such simple words as "garden," which he otherwise never misspelled. His interest in spelling of any word encountered seems to border on the compulsive, leading to the paradox that he will know the spelling of many more words than the meaning of them. The serial character in his spelling, then, appears independent of visual imagery and meaningful use. Astoundingly his number and calendar manipulation show similar characteristics.

8. *Arithmetic and Calendar Performance*

L. can add 12 two-place numbers correctly as quickly as called out by the experimenter. With the same speed he can reel off number series such as 1-20 forward and backward by skipping every second number and also can count by 15 or 16, e.g. 1-17-33-49-65, etc. At 15, his digit span is 8 forward and 7 backward. On the Woody Arithmetic Scale he solves many simple examples in addition and subtraction, but is inconsistent in that he makes unpredictable errors on other examples of equal difficulty, avoids certain fractions, while tackling others, and disregards decimals, dollar signs, etc. Characteristically L. is at first stumped with problems containing fractions because the fraction-stroke is printed at a 45° tilt on the test, whereas he has been accustomed to a horizontal stroke. Similarly, he cannot read a division problem requiring the $\div$ sign when the experimenter has written it carelessly as $\frac{\cdot}{\cdot}$.

This combination of success in rapid manipulation of certain numbers and of rigid limitation to a specific, mechanized procedure is evidenced in other test situations. At 11 L. has learned to deal with fractions and knows how many $\frac{1}{4}$'s and $\frac{1}{2}$'s and so forth make one whole, e.g. he succeeds in adding $\frac{3}{8}+\frac{5}{8}+\frac{7}{8}+\frac{1}{8}=\frac{16}{8}=2$. Yet he cannot add the total when the fraction is presented with a number in a series such as this: $12\frac{1}{2}+62\frac{1}{2}+12\frac{1}{2}+37\frac{1}{2}$. Or, after he has learned to find the common denominator of fractions like $\frac{3}{4}$, $\frac{1}{2}$, $\frac{2}{3}$ he becomes panicky if presented with more than 4 different fractions. Correspondingly he easily errs when adding or subtracting 3 to 4 place numbers. Here he has only knowledge by acquaintance but no rote knowledge. The question may be raised whether and to what degree L. has achieved a genuine, normal understanding of the meaning of numbers, of number relations and of quantity; whether his arithmetic procedures may be ultimately based on rapid counting to which drill has gradually added certain skills by rote.

To study this problem the following experiments are made:

(1) L. is asked "What is more, 5 or 8?

Ans. 5; 20 or 30? Ans. 20; 8 or 16? Ans. 8. "Why is it more?" A. Because it's more, because I mean it's more. Obviously he does not understand the meaning of "more."

(2) He is given the following 6 pairs of numbers, in the first 3 the accent being on the first, in the second 3 the accent being on the second numer 7′-12; 6′-8; 12′-7; 7-8′; 7-14′; 5-4′. Asked which is more in each pair he denotes always the accentuated number.

(3) He is shown the length of 1 ft. on a tape measure and then asked to indicate the length of 2 ft. with his hands. He shows 2 fingers instead.

(4) On two consecutive afternoons L. is given arithmetic examples of the type tabulated below. Only one task at a time is preented on the black board while L. looks on and is then asked to solve the problem. ("What does it make?") Except for the preliminary trials, the order of the 3 different types of task is deliberately not mixed, so that establishment of a set is favored.

Type I. Addition-subtraction:
1+1−1; 2+2−2; 3+3−3; 4+4−4; 4+3−3; 17+8−8; 144+122−122; 275+275−275:

Type II. Multiplication-division:
3×2÷2; 2×3÷3; 3×4÷4; 4×2÷2; 4×4÷4

Type III. Addition-division:
(1+1)÷2; (2+2)÷2; (4+4)÷2; (12+12)÷2; (15+15)÷2; (17+17)÷2; (275+275)÷2; (277+277)÷2.

Above tasks are selected in order to determine whether in each type of example L. will be able either to spontaneously discover the principle or to grasp it through the explanation and demonstration of the experimenter. The criterion of understanding the principle is whether L. can arrive at the proper answer without working out the solution stepwise by figuring out consecutively each operation. Is L. able to: a) Solve Type I problems without first adding number I to number II, then subtracting from their sum the same number II. b) Solve type II problems without first multiplying number I by number II and then dividing the result by the same number II. c) Solve Type III problems without first adding the identical number to itself and then dividing the sum by 2? The criterion of insight then is here the understanding of logical relations between numbers; to comprehend, for instance, that one does not alter a given number when adding to it and subtracting from it the same number and that therefore these operations are superfluous. The same criterion obtains for a given number which is to be multiplied and divided by the same number, and likewise for the task of adding the same number to itself and dividing the sum by 2 (the latter being the most abstractly hidden principle).

Preliminary trials:

To task 4+2−2 L. replies "4, 2, are 8, take away 2 makes 6." To 3+2−2 he answers "3, 2, are 6 take away 2 makes 4." Inquiry reveals that L. mistakes the plus sign for a multiplication sign, since, according to his mother, he has learned to write arithmetic examples in the following way:

$$\begin{array}{r} 4 \\ +4 \\ \hline \end{array} \quad \text{or} \quad \begin{array}{r} 4+4 \\ -4; \\ \hline \end{array}$$

also he is used to the words "and" for +, "times" for ×, "into" for ÷; e.g. he reads 3×3÷3: "3 times 3 and 3 into that" and then figures out all steps. This dependency upon a specific visual configuration and verbalization is so strong that the experimenter has to change the presentation on the blackboard accordingly and to explain +, ×, ÷ in L.'s vocabulary.

In spite of this measure the following behavior at first ensues: a) Perseveration, L. confounds the written + sign with the × sign. While reading the task he conforms in saying "plus" or "and" but actually multiplies, e.g. to 9+4 he says: "9 and 4 would

$$\begin{array}{r} -4 \\ \hline \end{array}$$

be 36. I am sure that's right, well, I don't know, it's the first time I ever had that."

b) Catastrophic behavior (18) leading to helplessness and to mistakes he otherwise would not make, e.g. to 1 + 1 he answers

$$\begin{array}{r} -1 \\ \hline \end{array}$$

"It's 3." To 4 + 3 he says "4 and 3 take

$$\begin{array}{r} -3 \\ \hline \end{array}$$

away 3, what is it, 5, I think it's 4, I don't know how to do it." To 17 + 8 he says "17

$$\begin{array}{r} -8 \\ \hline \end{array}$$

and 8 take away 8 that's nothing, I have not learned that." To (3 × 2),÷ 2 he says "6," and is then stumped. To (17 + 17) ÷ 2 he says "34, 2 into 34 is 7 . . . 13 . . . 17."

To $(277 + 277) \div 2$ he says "575 or . . . 4 I don't know." To $(12 + 12) \div 2$ he says "12 and 12 makes 24, 2 into 24 makes 8."

Experiment: These initial difficulties are overcome after several hours during which L. grows accustomed to the situation. Now he solves tasks of any type correctly, but always works out the solution stepwise verbally. Using his thus regained self-confidence the experimenter now tries to explain that L. need not figure out each step, that . . . "if you read 3 and 3 take away 3 you know it is 3, because you add and take away the same number."

The experimenter also writes the various tasks as follows:

Type I: $3 \boxed{\begin{matrix} +3 \\ -3 \end{matrix}}$

Type II: $3 \times \boxed{3 \div 3}$

Type III: $\boxed{2+2} \div 2$

and tries every means of promoting insight, e.g. instructs L. "Look at it this way . . . Read through the entire example before you figure it out . . . Look at the whole example before you answer . . . Try not to figure it out, get the answer by looking at it . . . Try to understand what it means before figuring it out . . . Just read what would come out." The result is that L. omits parts of his verbalization during his attempted solutions: e.g. to examples like $2 + 2$ or $4 + 4$, he inevitably says "nothing, $\underline{-2}$ $\underline{-4}$ 2"; "nothing, 4" indicating that he *first* subtracts 2 from 2, then gets "nothing" and finds 2 left over. He just omits the verbal phase of "2, take away 2." Under no circumstances can L. be induced to abandon the procedure of working out each step in succession, in any type of task. With the increased number of repetitions and variations however his speed improves amazingly. Whenever the presentation is changed, e.g. to $\underline{14}$ he answers immediately "7, 14"; $\underline{-7+7}$ or to $\underline{2}$ he answers "nothing, 2." A few $\underline{-2+2}$ times he gives the final answer without interposed verbal steps. In these cases however, either his lips move or he answers to the question: "Did you see it, or did you figure it out?" with "I figured it out." It seems L. finally interprets the task situation as the demand not to think aloud and he makes strong efforts to suppress vocalization of his "figuring out:" he looks rather pleased when he occasionally accomplishes this. At no time however can he even suppress the verbalization of the steps in Type II and III tasks. At no point does he give the slightest evidence of having "caught on" to the principle, to the possible economy in not working out the answer, of having wondered, why he always arrives at the first and same number with the termination of his procedure.

L. solves for example several tasks of the type: $(4 \times 4) \div 4$ by figuring aloud. This time the experimentor keeps all tasks on the blackboard asking L: "Is there anything alike in all these examples?" A. "Yes, it's a cipher." The experimentor writes on the blackboard $4 \times 4 = 16 \div 4 = 4$, points to the last number: "Look, what is this four?" A. "5" (L. has counted the number of ciphers). Exp. "Can you see what the first and last are?" A. "A cipher." After variegated prompting, L. eventually says, "They are the same." Asked, "Why?", he replies, "Because, it's the first and the last." Further inquiry reveals that L. grows aware of the fact that the cipher 4 is the "same" because it is at the beginning and at the end of the sequence, but not because the 4 remains unchanged in the calculation.

Calendar Performance. In view of these results it becomes a tantalizing problem to uncover L.'s procedure in answering the calendar questions. All attempts to obtain information from L. as to "how he does it" prove hopeless. He answers with his speech clichés such as "I don't know," Dr. G. . . . "Dr. S. . . . told me so", etc. There is no doubt that L. is wholly unable to render account of his calendar performance, even if he makes a sincere effort to cooperate in this respect.[1] This statement is based

[1] This is not uncommon among feebleminded "calendar calculators" (27).

on 5 years of experimentation during which all possible means have been explored to engage L.'s cooperation and to induce his understanding of the requests. The injunction: "Think aloud while you do it" yields scant material, and the attempt to hypnotize him by two professionals is futile. Actually rapport is better in direct instruction to "think aloud," because here L. produces at least some rapid but barely understandable vocalizations. Recording what he thereby utters rapidly in a half-tone voice is difficult.

He practically always produces an enumerative pattern of which the following is typical. Asked: "Which day is June 10, 1938?" he answers correctly "Friday" after mumbling quickly 20.31 31.30.31.30.30.31.31.28.31.30.31.10. It seems that he first subtracts 10 from the 30 days in June arriving at 20 and then counts off from this starting point to the following June. He also volunteers "that 10, 3, 17, 24 always gives Friday", which is true for this month of that year. Questioned, he knows at once all leap years from 1890 to 1950 and never errs in this respect in his calendar answers, just as he knows that in consecutive years each day of the week moves up one date.

From all verbalizations which can be elicited we gain the definite impression that L. knows by heart a number of week-days for certain dates in a given year or perhaps in several years and that he is rapidly counting from these "anchorage" points in units of months in the manner described above. In addition, some year around 1900 appears to function as an orientation-frame in his calendar knowledge since he answers more promptly and confidently questions in this region. At 15 his interest in the calendar has decreased. He claims, however, to have "built up a calendar which has 9 days in each week," which he calls "doinder" and tells how many weeks fall into the usual month, speaks of a doinder day in each week, but cannot explain what the word means, nor can anyone else in his surroundings.

Although the calendar manipulation is one of his spontaneous and most nearly "creative" activities, it is noteworthy that it is not integrated to a comprehension of the *factual meaning* of age in terms of "old" and "young." For example, after one of his usual calendar answers regarding Dr. G.'s and Dr. S.'s birthdays in a given year, he is immediately queried as to who is older, Dr. G. or Dr. S. He wrongly names the younger of the two, Dr. S., giving as a reason that "Dr. S. is born in June and Dr. G. in November." A person whose birthday is earlier in a just given sequence is "older" all right because he comes first in counting, but not because he is older in years lived, in experience and in looks. This conception of age is just as unformed as that of "Who looks older" between two individuals confronting him, a question which he cannot answer.

SUMMARY OF EXPERIMENTAL RESULTS

Analysis of Success and Failure; I.Q. Scores and Intelligence

L's I.Q. of 48-50 remains stationary from 11 to 15 years, placing him at the borderline between the low grade moron and high grade imbecile level. Although L. has been a problem child from infancy and had to be taken out of school, the presented case history recorded an I.Q. of 86-97 at 6, of 91 at 7, and of 87-102 at 8 years. L's behavior abnormalities, his learning difficulties throughout, and our qualitative analysis of the various standard test results leave, however, little doubt that he has always been intellectually subnormal. L. achieved better I.Q. scores at the ages 6 to 8, because his abilities in counting, in associative retention and immediate memory span sufficied for succeeding overtly on the corresponding Binet subtests. In this way he accumulated a total of *selectively* composed credits on test items that were commensurate to him. These were added to his basal age, and this sum total camouflaged his reasoning defect. At 11 and 15 the Binet test requirements increasingly involve *abstract reasoning* and offer less opportunity for compensation through attaining "credits" in his specialized skills. Hence his failures on the reasoning sub-tests naturally resulted now in a lower I.Q. Yet his I.Q. did not actually drop. Because of his basic intelligence handicap he simply could not meet the higher and more varied demands of intelligence tests for the older child, and therefore his handicap became now also detectable in terms of these tests. (17) This interpretation is supported by the fact that in all the performances we tested including that of music, L. showed abnormalities of function. His learning ability and variability was limited to a rigid specificity of behavior and motivation.

These and the I.Q. findings demonstrate the methodological necessity to study in each task the conditions under which a solution has been achieved or not, i.e. to determine experimentally the qualitative nature of the process: the "how" of the procedure in a successful or unsuccessful performance. (See the pertinent critique of the plus and minus method in clinical testing by Goldstein (18), Goldstein and Scheerer (22).) In our case the question has to be asked, how L.'s shortcomings, his low I.Q. score as well as his specific accomplishments, can be explained in terms of the functional processes involved. Are we to assume that he "excels" in his favored activities because, regardless of being an imbecile, he possesses unique capabilities which exist apart from and are not affected by the lack of his capacity for abstraction? Are we perhaps to assume that there exists no "general abstract" capacity, but only a composite of individual capabilities which are so independent from each other that a number of them can be impaired without affecting the remaining sum, permitting, for example, mathematical capacity coupled with feeblemindedness? A similar assumption seems to follow from Thorndike's concept of general intelligence, according to which higher and lower intelligence are solely distinguished by the greater or smaller number of associations. (60) If this is true, then L. should have theoretically been able to become a proficient musician and mathematician since he came into the posses-

sion of the requisite number of musical and mathematical connections, while gravely falling down on the multiplicity of non-musical and non-mathematical connections. Since this contradicts the facts of the case, such an interpretation would have to explain why L.'s specific capabilities did not develop to such a proficiency despite his "interests" and "training".

Another alternative to be considered is whether L.'s handicaps as well as his assets could be explained from a unitary point of view that is reconcilable with the facts. What does a qualitative analysis of processes underlying his "proficiencies" and "deficiencies" reveal? Are his proficiencies "supernormal" in terms of underlying functions, and if so, how are they operative in the framework of his entire personality; is there any difference between a specific talent embedded in a normal personality and embedded in that of a feebleminded?

CONCLUSIONS REGARDING THE DEFICIENCY SYMPTOMS IN VARIOUS PERFORMANCE FIELDS:

The General Defect as an Impairment of Abstract Attitude

Thus far our experimental findings sum up to this:

(1) L. suffers from an impairment of abstract attitude affecting his total behavior throughout.[2] This expresses itself in the linguistic sphere by his 'inability' to understand or to use language in its symbolic and conceptual meaning; to grasp or to formulate properties of objects in the abstract, (e.g. size, form color); to comprehend or to evolve word definitions, similarities, differences, common denominators, logical analogies, opposites, metaphors; to conceive of the idea of causality, to raise the question "why" regarding real happenings, to deal with fictitious situations, to comprehend their rationale. On the other hand this impairment restricts his speech to a qualitatively different level, to the grasp and use of language in a concrete, situationally determined and ego-centered sense.[3] On this basis he also acquires a great number of conditioned verbal responses, reproducing them mechanically at the recurrence of a situation. These speech automatisms include words and phrases of seemingly general meaning like "everybody knows", "in good respect" without such implication.

(2) The same impairment underlies his lack of social awareness and of curiosity in people, his limited values, his inability to register or absorb anything of the socio-cultural and interhuman matrix around him, of all that has significance for a normal child (even content of movies). Owing to his missing insight into the "raison d'etre" of "good" or "bad," he is in all avenues of conduct dependent upon conditioning methods through reproof or praise. For the same reason this training has to be constantly reinforced; even for the most elementary habits, e.g. neatness, shame, self-control, it reaches into his 14th year where the normal child has long supplanted earlier conditioning by social reasoning and imagination. He thus develops to a well trained "robot" but, in answering the telephone, making a purchase, he *cannot* decide when the situation changes slightly, make a choice between two offered alternatives. He shows the characteristic difficulty in shifting and rigidity,

[2] Throughout this text the terms abstraction, abstract behavior, abstract attitude or abstract capacity are used synonymously in the sense defined by Gelb and Goldstein (15), and Goldstein (18) and Goldstein and Scheerer (22). See also p. 37.

[3] See page 13 and especially page 9 ff. of this monograph.

as known in cortical cases.

Because no real understanding can develop about the cause of a disturbing experience, his fears of sounds, etc. persist into his 10th year and new ones are easily acquired. Whereas children usually develop and lose fears via the knowledge of the danger of an object, L.'s fears have little to do with knowing danger. (31) They rather originate from shock reactions to sudden stimuli in situations which he cannot understand in their broader meaning. The defective abstract attitude delivers him to the mechanical coupling of an emotional shock and a disturbing stimulus. (18) The "shallowness" of his feelings and personal attachments has to be considered in connection with his basic inability to encompass more than immediate human contact. His hyperkinetic behavior, flighty attention is typical of "forced responsiveness" in individuals with his impairment. (18,22) E. Kahn has included this case under the syndrome of "Organic Driveness" related to brain stem disorder. (33) He observed L. from his 6 to 8 year. Since then these symptoms have decidedly *decreased* while the basic disturbance became more pronounced. All our results therefore, indicate that the same defect which led to hyperkinetic behavior in L. when he was a young child led to a more rigid behavior when he grew older—a well-known occurrence in the feeble-minded. (17)

(3) The same impairment underlies his failures in visuo-motor performances. He operates on an inarticulate level of organization in the field of optic and motor function. This lack of differentiation can, however, not be assigned to a defectiveness of the visual and of the motor processes as such. L. fails in those tasks which require the operation of abstract thinking within the medium of visual or motor activity; i.e., in his visuo-motor acts he falls short in planning", "synthesizing", "centering", "grasping the essential" and conceiving of spatial relations. It is this ideational and cognitive function, the general "abstract" capacity which he lacks, and therefore his visuo-motor acts are deficient in their degree of articulateness, in their direction of centering and in their part-whole integration. The ideational and cognitive structuring of visual or motor acts is inadequate but not their specific elementary components. This reaffirms the hypothesis that any "complex" response in a specific function requires the abstract, "ideational" function; that visual or motor processes cannot be separated from the whole-process that is one pattern of ideational *and* of specific sensory or motor activity.

(4) The same impairment manifests itself in the field of arithmetic reasoning where his number conception is limited to grouping of simple units by manipulating one-place and two-place numbers and counting by 2's or 16's, etc. His difficulty in dealing correctly with larger numers indicates inability to grasp the symbolic meaning of numbers as representing place values in an ascending reference scale where the order repeats itself and with that, the place value (e.g. 5, 50, 500, 5000). If one does not comprehend this logical structure of the number system, one cannot transfer from small units of grouping to large ones, becomes confused by their complexity, not seeing the principle of identical place value (e.g. 5000, 50,000, 500,000). This also manifests itself in L.'s failure to understand logical relations between numbers in the abstract, e.g. $2 + 2 - 2$, independent of their consecutive connection. To grasp the meaning of this relation re-

quires more than two consecutive, opposite operations with number 2 succeeding itself with reversed signs; it requires the simultaneous act of viewing number 2 in two opposed *relations, cancelling each other out*: of seeing these relations as a logical cause for identity and not as a time sequence of separate steps. This handicap in abstract capacity of holding in mind simultaneously two different aspects, (18,22) is also at the bottom of L.'s difficulty in understanding concepts of size, quantity and age. Therefore his arithmetic performance is restricted to a stepwise consecutive procedure of counting or grouping, to an abnormally rigid dependence upon specific visual and verbal cues and manipulation by rote. If the task is altered even slightly, transfer from the acquired drill is extremely difficult, mostly impossible, indicating the absence of genuine understanding.

(5) The same impairment to abstract is evidenced in his calendar performance by his inability to explain or give an account of his procedure, so that he cannot even hint at the scheme he may be following. Hence his performance is rigidly bound to the situation in which it occurs, it cannot be lifted out of its concrete context for reflection and verbalization. It runs off automatically once it is set going and appears to be a combination of rote knowledge and very rapid counting, since the answers occur within 30". His calendar knowledge remains abnormally barren from any integrated understanding of age, time and historical succession (e.g. he cannot answer whether it was a long or short time ago that Lincoln died, although knowing how many years ago).

We thus seem justified in speaking of L.'s basic impairment in abstraction and to suggest a functional interdependence between this deficiency and the defective organization of his performances in many different fields. It may be argued that analogous interpretations have been applied to brain injured cases (18, 19, 21, 22, 23, 24) and that such a conceptualization is too general to do justice to the existing differences in etiology and symptomatology. Such argument overlooks the fact that an impairment of abstraction manifest itself in different symptoms depending on the particular condition, such as the cause and special localization of the brain damage, the degree of severity as well as the constitutional make-up of the individual and his personal history. The concept of abstract attitude is nevertheless justified because it reflects more adequately the functional interrelation of processes in various performances than does the traditional breakdown of mental processes into thinking, attention, memory, etc. How fictitious it is to speak of disturbances in thinking, attention, memory as primary while the patient thinks, concentrates, remembers amazingly well in one and not so in another situation, is now being more and more recognized. (7, 26, 37, 61, 62, 67) The concept of abstract attitude should therefore not be considered an over-all recipe for mere classification of symptoms of mental defect; nor should it replace the painstaking analysis of all defects in their qualitative nature and their quantitative aspects. On the contrary, in the probing investigation of the individual case, the concept of abstract attitude should serve as methodological frame of reference for examining the symptoms in different fields of performance as to their interrelatedness, and should render possible the understanding of these symptoms from a unitary point of view. If the abstract attitude is impaired, the various symptoms can be explained as ex-

pressions of this underlying change, and the particular expression of this change within that personality as-a-whole has to be studied. In so doing one has to expect great individual differences in the form of impairment as to the abstract and in the nature of restriction to the concrete level of behavioral organization.

CONCLUSIONS REGARDING THE SUCCESSFUL PERFORMANCES

1. *Skills and Abilities: L's Endowment*

In this light we may have to reevaluate psychologically L.'s "superiority" in arithmetic, spelling, music and verbal memory. Our analysis leads to the following conclusions:

(1) L. is apt to succeed in such tasks which permit a temporal organization in concrete grouping sequences. He can best cope with material via a successive procedure, e.g. vocal rhythm, or via stepwise, enumerative verbalization (viz. his mastery of numerical, rhythmical sequences, melodies, songs, word-series and spelling). This propensity does not necessarily result in unselective, mechanical, stereotyped behavior. To L. such material or aspect of material makes sense which can be dealt with through serially organized grouping, through serial acts of simple structure. Situations that have an "affinity" to this approach are concretely sensible and therefore apprehensible for L., so that he can cope with tasks which demand no other procedure. For the same reason he can also reproduce such performances accurately under similar conditions. (Correspondingly a normal individual tends to remember best what was sensibly organized for him.)

(2) The psychological functions that underlie this propensity are to be sought in the following: L. has an initial endowment of auditory receptiveness, of articulate tonal perception and of a fine musical and rhythmical sense; he is also equipped with tonal memory in music, with acoustic and kinesthetic motor memory especially in speech, supported by auditory imagery. This equipment appears to be a "preferential" medium of his reactivity and of his retention. The functioning of this equipment in L. is however, not activated by conscious deliberation but is purely situationally determined.[4] At 6 he has absolute pitch, at 3 he recognizes and at 4 reproduces melodies and rhythms astoundingly well. Before he can read, he masters many nursery rhymes. How his memory is coupled with auditory imagery is further indicated by his purely phonetic reproduction of arias in Italian and by his phonetic spelling of new words; by his immediate retention of their spelling when given it acoustically; by his ease in forward and backward spelling without visual help and by the corresponding verbal mastery of the digit span and number series in reverse. Before he can read or write numbers beyond 9, he counts, adds and skips numbers beyond 9. This, according to Binet, Mitchell and others (5, 39) signifies initial equipment with speech memory and auditory imagery. Without this equipment L. could not have at once retained the verbally given names for the keys struck on the piano, so that henceforth he immediately named the note upon hearing it without "sight" and without reading knowledge of the scores. His early fondness for music was coupled with such responsiveness to sound that he tended to become traumatically sensitized by

[4] The difference between involuntarily arising imagery and voluntary command of it has been neglected in normal and abnormal psychology. As Goldstein (19) and Zucker (17) have pointed out, this difference is important for the appraisal of pathological disturbances and defects.

specific noises or sounds, which presupposes involuntary auditory imagery. Although his visual imagery is subnormal, he masters the spelling of 100 words during his 5th year, having spontaneously learned the letters *aloud* from toy blocks. In contrast he never learned to write well and his written spelling was better if allowed to *verbalize* than if not. His speech development points in the same direction and towards an initially superior acoustic memory. Although his motor speech remained inarticulate longer than is normal, his word and sentence memory was excellent. (Aside from his repertoire of speech clichés, etc. his recital of the Gettysburg Address without understanding is here pertinent.) There is also evidence of kinesthetic retention in certain fields. He can write backwards with either hand, liked to dance as a young child, could tap out rhythms and melodies, and spontaneously played tunes on the piano with both hands, the accompaniment with one, the melody with the other hand. Some of his drawings show "kinesthetic" memory from practice or imitation, and his amazing Knox Cube tapping performance points in the same direction of kinesthetic rhythm, perhaps supported by speech cues.

(3) On the basis of his endowment L. develops an aptitude for successive activities especially in the auditory-verbal sphere. This is attested by his completion of the various XO series on the Army Beta test, preeminently through the medium of verbalization. From his third year on he begins to count and to call off number series and increasingly engages in verbal counting games from which he develops at five the "skipping" up to sixteens. From this emerges play-like verbal addition, and he now multiplies by *consecutively adding* the multiplicand number rapidly. This may serve as a clue for his "number sense." To L. acousto-phonetic sequences form concretely meaningful units of grouping in terms of rhythm, step-wise progression, etc. Whereas most individuals visualize the "number space" somehow, L. experiences and moves along the number system through an auditory speech medium, as a progression in time. Therefore his number manipulation in this medium has his natural limitation where complex figures and simultaneous grasp of logical relation are involved. In this respect it is interesting that Morrow recently found a correlation of .41 between tonal memory and number series, of .31 between "time" and number series. (41) It is highly probable that L.'s calendar performance developed on the same basis of auditory-speech memory-and-imagery in counting from the first given calendar through that year into the next year and so on.

(4) This leads to an important difference between L.'s endowment and that of a normal person. Owing to his impaired abstract attitude L. cannot develop his endowment actively and creatively. He cannot learn intentionally by following instructions in a systematic manner. His learning is limited to a more passive, unreflective manipulation. His endowment can only function as a naïve play activity in the concrete situation of "doing." What he can absorb in this way, executing it within the situation and without deliberate effort he will retain. Once failing in this leads to subsequent failure to learn at all and makes teaching virtually impossible. This is characteristic throughout and especially significant in music, where he is most gifted. He cannot practice, refuses to read scores which he reluctantly learned, cannot repeat musical sequences of his own de-

liberately or on request, etc. (cf. page 3). This playlike and situationally determined retention versus deliberate, volitionally determined learning characterized his entire memory organization. The same child who could not learn to tie his shoe, catch or throw a ball, light a match before his tenth year, plays with one hand an interval of a fifth on the piano, while the other plays a fourth in a tremolo of a running passage. The subtler motor coordination fails him where deliberate volition is requisite, but follows suit in a total "unreflected' situation. In the same way does he acquire spelling and numbers as a game with blocks and playful counting of objects. Paradoxically formulated, he cannot retain what he wants to remember, but only what he cannot help retaining. Whereas he suddenly knows how many quarters and nickels are in 75 cents, he cannot explain why. Whereas after playing with the calendar he suddenly knows the names of the week days for the months of the current and of the next year, he can never explain the "how" and "why."

(5) Perhaps we are face to face with the intrinsic process of talent as the unreflective, concrete forming of patterns that eludes us otherwise as "intuition." Decisive however, is the fact that without being imbedded in and steered by an abstract attitude, the direction of such talent is *abnormally* concrete, specific and sterile; it cannot become integrated with a broader meaning of the subject, nor with social insight. Thus such an endowment differs from its equivalent in a normal person, repudiating any notion of identity of traits or abilities. Instead of approaching a putative "identity" with a normal capability, L.'s endowment approaches rather a caricature of a normal talent. L. is sufficiently musical to appreciate Verdi's "Othello." But during 4 years he is so obsessed with an Othello record that he never reaches the saturation point through playing it to excess, and his parents can employ this as an incentive. His musical knowledge is limited to the number of records in the house to which he listens over and over again. He enriches his repertoire at an abnormally slow pace and never transfers his listening from Victrola to the radio music. In school he stops playing the piano when it is moved to another room. His spelling and counting begin with the infantile pleasure of functional enjoyment ("Functionslust" (6)). The application of his endowment to calendar knowledge grows out of this "functionslust" without genuine appreciation of time and age. On closer inspection the apparently superior achievements, based upon his endowment, reveal themselves not alone as sterile but rather superior by contrast. They stand out against the remaining vacuum of his total memorial repertoire and his general inanity. Compared with the immeasurable amount of incidentally acquired knowledge and skills in normal children, the concentration of L.'s incidental memory into such abnormally limited channels of retention is not really miraculous. If any normal individual would be forced to indulge in nothing but L.'s memorial skills, he probably could accomplish the equivalent.

(6) But who would indulge in these specialties, and practice such calendar manipulations; and why did L.? We suggest the following hypothesis: Simultaneously with the first symptoms of subnormality (e.g. his vocabulary and syntax development) L. begins to excel in counting and musical interest. While his further intellectual growth falls more and more behind, he begins to actualize

his natural endowment more and more within its possible optimum. Where other children ask for the names and the "why" of objects and events, L. is engaged in music, spelling, or in giving numbers to almost everything. At 5, pictures, blocks and games appeal only for playful memorization of numerical detail. One day, at 6, he says, "it is September 32nd," and receives a calendar with which he now begins to count the dates, etc. At another day he says to his mother, "You are playing the 25th note," knowing the position of piano keys by number sequence. He is told their real names and learns this new sequence at once. Because of his deficiency L. was driven to utilize his endowment for successive performances in every possible sphere. He clings tenaciously to this kind of procedure because it is *the only way in which he can come to terms with a world beyond his grasp.* He can cope only with situations which permit him to express his potentialities through these performances. Therefore he will also resort to this procedure and apply it indiscriminately when the task situation overtaxes his powers of adjustment and understanding. L.'s characteristic behavior throughout is to use enumerative verbalization whenever he cannot cope with the task (e.g. in the visual recall test of the ESP cards, in the Block and Object Sorting Tests, in pictorial description, in fitting hour numbers into the watch, etc.). Enumerative verbalization becomes a substitute activity for normal adjustment and mastery. It also becomes the chief avenue of self expression and for the establishment of some positive contact with his social surrounding, in terms of "rapport", and "recognition". To illustrate: He greets us after an interval with statements such as "There are 47 days to your birthday" . . . "I have not seen you for 102 days," or during a silence in the room he suddenly says, "We are 4 people here."

In this sense L.'s development exemplifies the rule that every human organism strives to actualize his capability to its optimum. A defective organism however is driven to an abnormal degree to exercise those functions which nature permits him to develop, because these are the only performances through which he can actualize himself and come to terms with his surrounding. (18, 20, 22) From this vantage point and on the basis of our findings, L.'s emotions and "motivation" cannot be separated from his impaired abstract attitude. The role and direction of his motives differs from that of a normal person and operates in accordance with his handicapped personality configuration. His lacking abstract attitude prevents him from conscious realization of his defect and from consciously determined motivation to perfect his capability; it limits him to the non-conscious impulse to deal with all situations through the optimal use of his special endowment, whether that is adequate or not.

It may be tempting to evaluate the motivational factor in L. in the light of Woodworth's thesis that mechanisms of adjustment become drives, (65) and in the further light of G. W. Allport's concept of functional autonomy. (2) L.'s development seems to point to similar processes as implied in the above terms—with one necessary modification. The pathology of the case restricts the functional autonomy to a mechanism operative on a primitive and diffuse level. L.'s deficit does not permit a process of perfecting his skills and at the same time leads him to the impulsion to use them without discrimination. In this sense the term "Idiot savant" is self contradictory;

inasmuch as L. is "savant" he is this because he is an "idiot" and not in spite of it. Inasmuch as L., is talented, his subnormal personality has to actualize his endowment through abnormal channels as a substitute for normal adjustment. For this reason L.'s endowment remains unproductive and restricted to such specialties to which a normal individual would not aspire.

2. *The Dependency of Endowment on the Organization of the Person-as-a Whole; Talent and Intelligence*

The following inferences are suggested by our findings:

(1) The function and development of an endowment depends upon the organization of the person as a whole. What William Stern called an "instrumental" or "directional" disposition (56), and what we called an endowment cannot be evaluated apart from its embeddedness in the personality structure of a given individual; therefore, different individuals cannot have identical "elements" or "traits" comparable and measurable in isolation. Neither can we treat the various capacities of an individual as a "sum" disregarding how they are functionally interwoven. As Stern aptly put it, "A composite picture of endowment can never be secured by merely summing up the separate accomplishments as a mosaic. On the contrary the part played by a special ability depends upon the structure of the talent and its anchorage in the person." (56, p. 319)

(2) The above statements are equally relevant to the function of intelligence. It seems inadequate to conceive of intelligence as the sum total of specific, mutually independent abilities, or of independent group factors. The investigations by Alexander (1), Garrett (14), and Morrow (41) contradict a multiple factor theory of intelligence on sound experimental and statistical grounds. Though the group factor studies have not dealt with the dynamic side of intelligence functions, the factual results are in general not in disagreement with the view here advanced. Closest to the conclusions in this paper comes Morrow with his formulation of the general factor he found: The factor " 'I' is the configurational or coordinating factor, integrates the abilities into ordered activity." (p. 508)

(3) In this light, one may have to reexamine Thorndike's concept of intelligence and his differential criterion for its greater or lesser degree. It is maintained that higher and lower mental processes are the same in kind, that the kind in which they are the same is mere association, and that the higher processes involve no cognitive process other than association, and that a difference in degree of native intelligence is a difference in the number, not in the kind of associations of which the individual is capable. Thorndike's further hypothesis "credits the quality of the ideas that a man acquires and the truth or falsity of the judgments . . . the validity of the inferences which he draws from any given data largely to his training." (60, p. 416) Our case may add empirical evidence to the penetrating critique by Wyatt (66) of this reduction of intelligence to the greater or lesser amount of available associations. The instances in which L. excelled in number of associations might qualify him as highly intelligent. Obviously it is not the quantity but the quality of "judgments," of "inferences," that distinguishes the imbecile level from the normal intellect. Thorndike's answer that this qualitative difference is a product of training seems to beg the question, because one would have to ask why an individual cannot learn the 'ade-

quate' associations, whereas he can acquire too many of irrelevant ones. Admitting the capacity for discerning relevance in associations would, however, force the acceptance of cognitive processes, of grasping essential relations. It would necessitate the acceptance of an organizational and directional quality in thinking that cannot be accounted for by a greater quantity of associations. Our case seems to support the other alternative; the process of understanding is prerequisite for acquiring relevant "associations." If a defect in abstract capacity impedes this process the individual is reduced to a level of blind and "supernumerary" associations. Closer to the facts seems therefore the statement that L. could not learn the relevant "associations" because he lacked in "cognitive" function to begin with, which lack, however, did not prevent him from acquiring a great number of associations—(if the outer and inner conditions favored such connections in L., as e.g. reward, punishment, experience of success, functional pleasure).

Our comments are directed chiefly against Thorndike's concept of intelligence as he formulated it in 1926 (60). It seems, however, his recent views on the subject have not changed. The following is a quotation from "Human Nature and the Social Order," 1940, p. 288: "The ability to reason is now known not to be a primary quality or essence—a force over and above the laws of mental habit or association—but a secondary consequence of them. Man forms mental connections just as animals do, but he forms, ordinarily, an enormously greater number of such. As a by-product, so to speak, of this multiplicity of connections, his powers of abstraction, generalization and reasoning are developed. In some extremely dull men, who form relatively few, reasoning and its correlates do not appear."

3. *Learning and Endowment; Learning Through Association and Through Understanding; The Role of Concrete Gestalt Function as the Basis of Special Endowment, and the Role of Abstract Attitude in Learning*

(1) L. presents an interesting object lesson regarding the merits of rote learning and of conditioned response training in theory and practice. His conditioned responses are well "stamped in", e.g. his speech clichés, "goodbye, give me a kiss" addressed to everyone indiscriminately, etc. He acts as the principles of association would dictate. He possesses, for example, many associations to Lincoln, as proven by his flawless recitation. Doubtless he could acquire many more. But large as their number would grow they could not sum up to the understanding of the character and life of Lincoln. In many instances L. behaves as conditioning theory could depict normal learning. Yet, his thus acquired responses in mental operations and social repertoire are mechanical stereotypes. They are either indiscriminately attached to unstructuralized total situations ("generalized responses"); or they are rigidly specific, so that unessential changes in the stimulus constellation cannot be met by transfer. L.'s failures in this respect demonstrate that conditioning without insight is inferior to learning by understanding and that understanding involves an organizational capacity and process different in quality from mere association.

(2) The terms "conditioning," "association," "associative speech memory," etc. have been used rather loosely throughout this study. From the point of view of Gestalt theory, this usage could be criti-

cized by reminding us of a number of "fundamentals," such as: Even rote learning is more than the establishment of purely mechanical bonds, because it involves a certain degree of organization, e.g. rhythmization or grouping in patterns-as-wholes; it is this process of "configurating," that determines the togetherness of the elements in recall; whether the elements are perceptual or motor, it is their structural relation that is grasped and that constitutes the configurational "sense" of the material to be retained. Be it a visual form, an acoustic or motor sequence, even nonsense series, learning is not sheer repetition of piecemeal connections, but a Gestalt process of realizing structural wholes. (34, 35, 54)

We are principally in agreement with these tenets of Gestalt psychology which have been recently reevaluated in the experimental investigations of Katona (34). Indeed in a closer analysis of the learning processes through which L. acquires his various skills and responses, we have to distinguish different ways in which he learns. Undoubtedly he retains musical and acousto-motor sequences by grasping them as whole-patterns. In the acoustic and verbal sphere it is the aspect of tonal movement and temporal grouping of the material that has structured whole-quality for L.'s immediate perception. Here he does not piece together discretely perceived elements connecting them associatively. Here his learning is "configurational" as regards rhythm, melody and speech sound sequences. One may well speak of a learning in terms of concrete sensory-motor Gestalten. We have already pointed out how material which can be organized in this form appeals to L.'s potentialities and that these kinds of grouping sequence make therefore concrete sense to him. His mastery of the primitive Gestalt-sense in this type of material is, however, an asset as well as a handicap. It is an endowment on L.'s credit side as for instance, in his tonal and vocal memory. But since this is not integrated with a normally functioning abstract capacity, it operates indiscriminately, as a coping mechanism and as his chief retentive reaction. The lack of abstract function prevents L. from reaching beyond his concrete grasp of auditory-motor Gestalten and from understanding adequately their meaning as symbols or their social significance. He therefore attaches blindly and automatically such Gestalt patterns to situations or to externally contingent stimulus cues.

The result is that he learns in two ways. First, in appropriate situations, L. retains easily "Gestalt-reactions" in the auditory and verbal sphere. Second, he reproduces these reactions on a mechanical basis of either rigidly specific bonds or diffuse situational conditioning. Therefore his social behavior, for example, abounds with stereotyped speech clichés uttered without understanding. In this connection it is noteworthy that Katona formulated the difference between retention as depending on understanding and retention as depending on associative learning (which he calls memorization) as follows: "Memorization may be regarded as a case in which organization reaches its 'limit'; it is resorted to under circumstances which are not suitable to understanding." (p. 247). This distinction seems also pertinent to our case. Whereas in Katona's experiments retention by drill was imposed upon the subjects through the experimental techniques, this retention was frequently forced upon L. through his pathological deficit. The inability to grasp relations in their relevant sense and abstract meaning delivers L. to the external mechanism of "associative" coupling.

III. Discussion

Abstract and Concrete Attitude, Intelligence, and Special Ability

The Problem of the Idiot Savant; Normal and Abnormal Channeling of an Ability as Adjustment and Self-Actualization

Whatever has caused L.'s deficiency, no doubt can arise about its general nature which defies the attempt to relegate this clinical picture etiologically to a segmental defect or to explain it by a conglomeration of unrelated defects. On the contrary, as it seems, our findings revealed with empirical stringency a unitary disturbance, an impaired abstraction, which accounts for the consistent character of his symptoms in diversified fields. It may therefore be of some importance that the result of this case study points to a functional relationship between abstract capacity, intelligence and special endowment. We may ask: What further inference would these results justify, how would they bear on this question of personality organization in general, and what would they imply for the problem of idiot savant, in particular? The following generalizations seem pertinent:

(1) The abstract attitude is essential for the normal functioning of "intelligence." L.'s I.Q. score of 50 on the Binet at 11 and 14 years was caused by failures on sub-tests which specifically require this attitude. Impaired abstraction was likewise patent in his failures and in the type of his errors in all other standardized tests. It would be redundant to reiterate here our detailed analysis of this impairment in his experimentally tested and observed spontaneous behavior. For the sake of clarification, however, we should like to present at this point a condensed description of abstract behavior as elaborated by us elsewhere (22). It is our contention that every deficiency symptom of intelligence which was found in L. can be correspondingly matched with a positive characteristic of the abstract attitude.

It is one dimension of the total personality, a common functional basis for a range of manifold performances all operationally interrelated. As a capacity level this behavioral range encompasses, on the plane of conscious and volitional action, processes as the following: to grasp essential relations of a situation or given context; to behold simultaneously different aspects of the same situation or object, to shift from one aspect to another; to understand a general frame of reference, a symbolic meaning as relation between a given specific percept and a general idea; to evolve common denominators, to reason in concepts, categories, principles; to assume different mental sets; to analyze given wholes into parts and to re-synthesize the so isolated parts; to plan ahead ideationally in thinking or visuo-motor activity; to behave symbolically (e.g. demonstrating, make belief, etc.); to reflect upon oneself, giving verbal account of acts; to detach one's ego from a given situation or inner experience; to think in terms of the "mere possible," to transcend the immediate reality and uniqueness of a given situation, a specific aspect or sense impression.

From the above criteria and our case study it is suggested that there exists an intrinsic relationship between abstract attitude and intelligence; that the abstract capacity is an organizational factor of a qualitative nature which cannot

be reduced to a sheer quantity of more or less associations. Neither can intelligence be explained by such summative aggregate and be divorced from the understanding of relations and their hierarchic relevance.

(2) It is our further contention that the mental processes effective in L.'s mistakes, failures and successful performances correspond to the behavioral characteristics of the concrete attitude: It is one behavioral dimension of the total personality which is functionally common to seemingly diverse psychological processes. It is that level of doing and experiencing which encompasses the 'immediate-given' in outer and inner stimulation and the direct reaction to it. More precisely, on this level we come to terms with stimulus contents in a naïve realistic form. We react to that experiential aspect of the given situation which in immediate apprehension appeals as something real, of tangible sense to us.

Here we are not guided by conscious activity in the nature of deliberately inspecting, interrelating, interpreting the meaning of stimuli and selecting responses; of self-aware discursive reasoning. We rather unreflectively surrender to an outer or inner experience; we are given to direct impressions as they issue immediate claims of palpable sense and "onceness."

Our thinking and acting are directed by such immediate claims as they arise from the particular aspect of a situation which is unreflectively apprehended as the commanding "foreground." This becomes the directive center of our behavior. Depending upon the outer and inner conditions the so-experienced foreground and demand character in the phenomenal field will differ. Given contents will organize phenomenally as to claim responses in different forms. Thus we may unreflectively react to the sense of—

(a) Situational belonging,—e.g. a tangible means-end-appurtenance; a manipulative fittingness or valence; a practical usage; a situational familiarity; an automatized behavior pattern or set; a feeling tone, a mood, a sentiment, an emotional impulse.

(b) Perceptual impressiveness,—e.g. a particular sensory vividness of a color or shape or object property; an expressive feature of physiognomies or things; a perceptual belonging such as palpable togetherness of objects in a configuration; a special Gestalt pattern, a rhythmic form; an obtruding congruency or sensory cohesion of kindred things, colors, object qualities.

(c) Subjective realism,—e.g. we do not manipulate with ideas and thoughts in their abstract general meaning; rather we are in the state of "literal-mindedness," as it were, manipulated by the subjective realness of the content of an idea or thought; of its palpable substance in its immediate uniqueness and context. Ideas may attain concrete might with thing-like corporeal qualities. Hence we do not deliberately call up and command images, thoughts, ideas, desires, but they are thrust into the foreground of inner experience in an ego-centered context or situationally determined way. If not checked by conscious control they may acquire monopolizing realness and the potency of compelling valences, as in compulsions, obsessions, and forced responsiveness. Thoughts may become commands, and desires, the compulsion to act.

In the concrete attitude our ego is not as detached from the outer world or from

an inner state as in conscious volitional activities. Therefore we are liable to be passively dominated by the individual demand character as thrust in the experiential foreground. The claim which the particular aspect of the stimulus situation exercises becomes a bond between the responding individual and the specific phenomenal organization. Because of this bondage the individual cannot easily detach himself from the demand exerted by the experienced uniqueness of that aspect. Therefore it is difficult if not impossible for him to realize *other potential* functions of the stimulus object, for instance to isolate it from its given sphere or context, to see it in another context, or to conceive of it as a symbol, an instance of a general principle or an example of a class, a representative of a category. This dependency upon immediate claims can take on the characteristic of rigidity and lack of shifting; but it also can take on the characteristics of fluidity which manifects itself in extreme susceptibility to the varying stimuli in the surroundings. The stimuli are followed as if always newly arising; the person is delivered to their momentary valences. This may appear to be distractability or continual spontaneous shifting of attention, whereas in reality the individual is being shunted, passively, from one stimulus to the next.

(3) An endowment in the sense of an unlearned capacity in a specific area of performance can, to a certain degree, be actualized on the level of concrete behavior. There is some indication that certain talents as, for instance, rhythmic and musical sensitivity, or serial grouping ability in the form of primitive number manipulation, are genetically anchored in concrete processes, e.g. in sensory-motor patterns of Gestalt character. These processes may develop early in life, even before speech is fully matured (50). They appear as an unreflective, heightened responsiveness to a particular medium.[5] However, because of its intrinsic role in grasping meaningful structures and symbolic relations, the abstract attitude is conditional for the normal functioning and exercise of a special endowment. Otherwise a talent remains restricted to an abnormally concrete level, sterile and rigid. In this sense the study of a "sub-normal" case may warrant general inferences regarding the usually concealed functional interrelatedness of talent and abstract attitude in the configuration of the normal personality.

(4) Implicit in our interpretation of L.'s development there was another thesis which may have bearing on similar cases. A defect in abstract attitude does not alone impose specific limitations upon a talent, but also 'disfigures' its *developmental direction and use* as compared to normalcy. We advanced the general hypothesis that a defective organism is driven in an abnormal degree and direction to exercise those functions which nature permits him to develop, because these are the only performances through which he can come to terms with his surroundings.

The term idiot savant therefore appears to be a misnomer. Inasmuch as it implies *normal* performance in a special ability coupled with amentia, it is misleading.

Inasmuch as it simply implies a special endowment in some aments, it is pretentious.

Inasmuch as it implies intrinsic su-

[5] Cf. our own case and for example Révész (50, Pp. 7, 17, 27) "even before the period of proper development of speech, the vocal reproduction of heard melodies was accomplished without difficulties." (2nd yr.)

periority in the peculiar manifestations of a defective organism's adjustment, it mistakes the anomalous for the supernormal. What often appears to be extraordinary in the accomplishments of talented aments is actually the "channeling" (42) of some ability through its unique exercise which provides the chief avenue of self-expression and adjustment. This in turn, may lead to a primitive type of "functional autonomy" in motivation.

Idiot savants are talented aments who possess an "amented" talent. Indeed, it seems true that different aments are gifted to varying degrees. *Certain* aments may possess an initially distinguishing endowment, such as musicality, in which also normal persons differ from each other (42, 44). But in the amented individual such endowment does not operate as in the normal, and it manifests itself only under special conditions. In *other* aments an ability comes into relief simply because it *exceeds their general* mental level without reaching normal function. Thus excellence in a certain performance as, for example, memory for certain events need not result from a specific endowment. Stimulated through definite situations, the ament may activate his least impaired function as a coping mechanisms of adjustment and "canalize" his energy and responsiveness into this specific direction.[6] In *certain* respects the above generalizations are concordant with R. Pintner's pertinent remarks, who wrote: "To the old fashioned observer, who thought of the idiot as a thing apart, belonging to a different species, it must have been a decided shock to find one who could recite pages of a school reading book from memory or remember all the birthdays of the children in an institution or construct presentable objects from wood, and so forth. To the psychologist, thinking in quantitative amounts of intelligence, it is not surprising to find individuals of mental ages from seven to ten doing these or similar things, when he considers what a mentality of seven to ten can accomplish plus the results of much practice, and making allowance for the presence of special abilities in limited amount among the feeble-minded just as we find special abilities among the normal" (44, pp. 609). On the *other* hand our findings suggested that the answer to the *psychological* problem of idiot savant is incomplete if one attempts its solution only in terms of quantitative measures of intelligence and "limited amounts" of ability, omitting a qualitative analysis of the performances in their relation to each other and to the motivational adjustment of the person-as-a-whole.

[6] We are using the term "canalization" in the sense as defined by Murphy (42). For completeness' sake it may be pointed out that a probable difference exists between canalization in the normal and the abnormal individual. In the cases referred to we are rather dealing with a "funneling" of all available energy into one direction, whereas in normal development a multitude of canalizations may occur.

THE PROBLEM OF THE IDIOT SAVANT IN THE LITERATURE AND OUR INTERPRETATION AS A WORKING HYPOTHESIS

1. *Other Definitions and Theories*

The hypotheses presented and issues raised may invite comparison with other treatments of the problem of "idiot savant" and cases recorded in the literature. A certain difficulty in their evaluation arises from the incompleteness of the reported data. The first lack is often the insufficient analysis of the constituent factors of the mental impairment, of its quantitative and qualitative nature. Second, a scrutinizing account of the pro-

cedure utilized in the credited specialty is also rare. Regarding the first shortcoming, one has often classified individuals as idiot savants whose intellectual handicaps remained scientifically undetermined. Of the cases mentioned by Barr (3) and Tredgold (59), partially based on Down's observations, many were not studied with adequate techniques and cannot be considered sufficiently diagnosed. The so-called "cretin imbecile" and celebrated painter Gottfried Mind, whom Tredgold describes, died in 1814 when neither endocrinology nor clinical psychology had developed. Undoubtedly many a case referred to by these and other authors around 1900 would be differently diagnosed with the more refined techniques of today. One need only think of the variety of reading disabilities which today are diagnosed and treated and which previously condemned a child to helpless illiteracy with the possible verdict of feeblemindedness.

Of late one therefore encounters increasing scepticism of earlier listed idiot savants particularly concerning the authenticity of their inferior intelligence and its primary nature. It is not surprising that in 1931 Pintner (48) records but three publications on "idiot savants" where the results of intelligence tests were included. He accepts only one of these as "qualified" idiot savant (studied by Minogue (38), ruling out the two others because they were not true aments. It should, however, be noted that Minogue's 23-year-old feebleminded who was conspicuous in musical memory and piano aptitude was diagnosed by the author as suffering from secondary mental deficiency. He had been normal up to the 3rd year and began to deteriorate following meningitis at this age. Other authors as e.g. Wizel (63) describe under the category of "talented imbecile" patients who following brain injuries manifest a special aptitude. From the published reports we have however, not been able to find evidence of "normalcy" of a talent; either its voluntary command or the procedure was specifically limited. It further seems doubtful whether such cases represent true amentia or rather dementia in an originally normal person resulting from brain injury. It is open to question whether this type of pathology affects the development of a talent in a manner identical with amentia. Recent studies by Werner and Strauss (62) have called attention to characteristic developmental differences between feebleminded children of "endogenous" and "exogenous" etiology.

The necessity then of accurate diagnosis and thorough psychological study of such cases is apparent and becomes more and more recognized as clinical psychology progresses (30, 48, 62). More and more idiot savants have been found to be either high grade morons or psychotic, as, e.g., the two cases reported and diagnosed by Goddard (16), the first having mechanical drawing, the second artistic drawing ability. The best renowned idiot savant, of whom Tredgold deals extensively, was the "mechanical genius" of Earlswood Asylum. He showed remarkable skill in drawing and construction, but was congenitally deaf and as a consequence was never admitted to any school. Tredgold leaves it undecided whether the alleged amentia was primary or a secondary condition which indirectly developed from his deafness and isolation. He lists him as an example both in his chapter on "isolation amentia" and in that on "idiot savants." Pintner (48, 49) considers this "genius" not intrinsi-

cally deficient but deaf and most likely a psychopath. As complex and intriguing as the case material on idiot savant is the theory attempting to afford a psychological explanation of this phenomenon. Among the hypotheses advanced in the literature we have found the following 6 types, each represented by one or various authors.

(1) Jones (30) introduces the concept of an "atypical focalized habit system". This may consist of "patience" in the preferred line of activity, for example deliberate memorization; of compensation for physical or mental inferiorities; of identification with a person such as the mother who serves as a model for the specialty.

(2) Brill (9) invokes three factors: An unconscious memory in terms of inheritance of acquired characteristics in the family tree as the basis of the special ability; adjustment to this "fragment of phylogenetic existence" by expressing it in a particular performance; regression or fixation to the oral-anal phase in infantile sexuality (this particularly with reference to mathematical prodigies and talented aments who began counting with pebbles or edible objects).

(3) Jaensch (28) generalizes the findings in one case of a "calendar calculator" in postulating eidetic imagery and the use of some schematic procedure.

(4) Tredgold assumes either some "primary developmental anomaly" or "some early fortuitous circumstance which has aroused the child's interest in a particular direction and thence led to the concentration of all his mental activities upon one object."

(5) Morgan (40) places the blame for idiot savants on "injudicious education." "Those who have in their care one showing a peculiar aptitude in some line are tempted to give him special training in that direction to the exclusion of other types of work. Consequently he becomes unbalanced, a freak genius."

(6) Phillips (47) and similarly Parker (46) entertain the interesting and tantalizing hypothesis that one talent assumes "not only the hegemony among all other abilities but crushes them almost to the point of extinction". Naturally, the intellectual deficiencies in such cases then spring from an "excessive intellectual quality and achievement in one direction."

Last but not least we find that with the increasing standardization of aptitude and intelligence measurement, the technical definition of idiot savant has become increasingly controversial. Whereas Pintner (48) restricts the term to any "idiot or imbecile who possesses extraordinary talent in some special direction," Morgan (40) and similarly Tredgold reserve it for "a feebleminded individual of any grade who has some special talent." With that they extend the definition *beyond* the imbecile level. The difficulty with these definitions is their restriction to the criterion of I.Q. measurement. Especially with I.Q.'s above 50 we cannot be assured that the condition is always rooted in impaired abstract function or whether it is due to other personality disturbances and handicaps. Jones (30) and in a more recent study Rothstein (52) called attention to the statistical problem in the definition of idiot savant. Both raise the question whether characterizations such as "phenomenal", "extraordinary" or "talent" are used in comparison with the *average* normal, or with the *feebleminded* population, or in comparison with the general ability level of the given feebleminded *himself*. In line with this criticism Roth-

stein wants to distinguish between talented aments and idiot savants. In the first group he includes any "amented individual either of idiot, imbecile, or moron level who possesses an aptitude which exceeds his general mental level but is inferior to the same aptitude in an average individual of the same chronological age." In the idiot savant group he includes an "amented individual who by comparison is superior to the same aptitude in the possession of an average individual of the same chronological age" (p. 90).

Summarizing, one may therefore conclude that at this stage the formulation of the problem is rather obscure and agreement on its solution is wanting. One has incorporated under the designation of "idiot savant" a variety of cases without adequate scrutiny of the nature of the deficiency and of the procedure underlying the exhibited proficiency. We suggest that the reasons for the diagnostic difficulties may lie in the insufficient appraisal of the role of the abstract function in performances on intelligence and clinical tests. We therefore propose to analyze the available case material from the following points of view:

(1) Irrespective of I.Q., the performance level has to be tested for the functioning of abstract attitude and the extent of its possible impairment. One further has to determine whether the performance in the credited *specialty* is achieved through a normal procedure, and whether its utilization is normal. Restriction to specific and rigidly concrete processes indicates anomalous procedure. Lack of discerning use and of voluntary control of the aptitude indicates anomalous utilization.

(2) It may be crucial to consider only those cases as specimens of so-called "idiot savant," i.e., cases of talent or skill in amentia, where abstract impairment is ascertainable. Where this is not the case, other factors may contribute to a low I.Q. score so that we are not actually dealing with talented aments, but with talented individuals who suffer from secondary handicaps as, for example, psychotics or psychopaths. To determine the presence or absence of impaired abstraction, it seems advisable to apply the testing methods described by Goldstein and Scheerer (22) which have been specially constructed for this purpose. Among others, M. Bolles has already shown that these tests are also suitable to diagnose abstract impairment in amentia. (Arch. Psych. No. 212, 1937.)

(3) It may be advisable to distinguish between talented aments and dements. It may be an important difference whether a talent had been patently or latently present and an impairment of abstract attitude was subsequently incurred as, for instance, in brain injury, or if such impairment was present from birth. The modification of a talent already present in the premorbid state may differ from the manifestations of a talent in an inceptionally amented individual.

Regarding points (1) and (2) the findings of Rothstein are of interest. He studied 8 talented aments at Letchworth Village with a battery of aptitude and intelligence tests.[7] The significant quantitative result of this testing experiment, first of its kind, seems to be the following: the apparently small number of subjects is statistically a representative sampling, for these 8 subjects were the only talented aments in the population of 4000. When tested in their special aptitude 6 of the subjects failed or were be-

[7] The number was originally 10 but 2 had to be eliminated because of too high mental age and suspected psychopathic personalities.

low average on the standardized aptitude test, two obtained average scores. On the other hand most of these aments made certain striking performances in their specialty, if given freer opportunity to exhibit their aptitude on their own terms and in their specific ways. Rothstein sums up his findings: ". . . although a specific performance of an ability is readily manifested by almost every subject, on attempts to measure the . . . ability, utilizing standard tests and batteries the results were negative. Thus assuming that some ability was present, one was forced to conclude that the various tests and batteries failed to tap the ability in question because of its *narrow range and specific character*" (p. 89, italics ours). This statement is substantiated by the following observations taken from Rothstein's records which we shall supplement by other case material so indicated.

2. *A Critical Analysis of Case Records*

Subject B.Y., C.A. 38, M.A. 3-10 years, knows the answer to problems with roots of four digits almost instantaneously and is rarely wrong. He can multiply just as quickly one to four place numbers with a multiplier of four digits. Because of his speech handicap it could not be determined whether he knew the answers from memory, acquired during many years of preoccupation with numbers, or whether he actually calculated.[8] On all standardized mathematical aptitude tests he failed, unable to follow the simplest instructions. He also failed when presented with simple problems in addition or subtraction, and could not be taught to perform these. One of the present writers (M.S.) had opportunity to see this case and observed that B.Y. would inevitably convert an addition or subtraction problem into multiplication by crossing out the plus or minus sign on the blackboard and replacing it by a multiplication sign. Of course he would add correctly *within* the context of written multiplication, but could never be induced to do this *outside of this context.*

This case should be considered in comparison to Wizel's "imbecile" patient. (63)

She had become temporarily mute, permanently epileptoid and blind after typhoid infection at the age of 7, and developed at 17 arithmetic skill to an amazing degree. She used a specifically concrete procedure, derived from counting coins and buttons in groups, preferentially of Hence she inevitably broke down multiplications like 23×23 into $33 \times 16 + 1$, 14×14 into $12 \times 16 + 4$. Yet in addition and subtraction she was remarkably poor, erring frequently, e.g., $57 + 63 = 141$. In division she was comparatively slow except for dividing by 16, but she knew the squares from 11 to 99. Another peculiarity was that she always answered questions in rhymes, sometimes correctly and sometimes senselessly.

Three other cases with specific number performances and memory feats should be included here because they were actually tested. Two were so-called *"calendar calculators".*

Lafora (36) studied a 16-year-old boy with an I.Q. of 65. The test yielded the result that "the aptitude does not consist of true calculation, but in the operation of mechanical memory of different dates for each years"; Leaning upon "coincidences of certain dates" which are remembered with precision, the first day of each month can be told from rules fixed in memory.

Jaensch (28) examined an 18-year-old eidetic feebleminded who answered calendar questions from 1920 to 1927. His performance was based on eidetic imagery of calendar days. He could not answer questions

[8] Square and cube root problems seem to be favorites among many talented aments as well as arithmetical prodigies. It is noteworthy how Mitchell (39) explained these feats in prodigies: ". . . those who made a specialty of square and cube root problems either depended on 2-figure endings, resorting to guess and trial when the given numbers were not perfect squares or cubes, or else *kept in mind the squares and cubes of many or most of the numbers up to 100 and beyond.* Such methods would work fairly well when the root contained not more than 5 or 6 figures" (p. 112, italics ours).

outside of this period unless first told a day of another date of the year in question. He could not make allowances for leap-years because he was unable to divide by 4.

Otis (43) tested a 19-year-old boy (I.Q. 81; MA 12) who showed "phenomenal memory", recalling with facility anything he had learned, dates, places, events, names, etc. On the tests he "succeeds in those tasks which are quickly done and fails utterly in tasks which are of fairly long duration." He cannot repeat 8 digits forward. His score in errors and time on various performance tests is so bad that lack of comprehension is indubitable. (MA ranges from 5–6 to 8 on Porteus Maze, Mare and Foal, Goddard Form Board, Healy). On the Manikin he reverses the arms and cannot complete the feature profile and two figure Casuist Form Board. Conclusions: "The mental tests do not startingly demonstrate any unusual capacity along one line. The unusual memory present in this patient does not in itself alter the scores on the mental tests to any appreciable degree."

Returning to Rothstein's records,:

Subject G.X., C.A. 42, M.A. 9, was normal up to the third year when he "contracted spinal meningitis." He can play the piano, reproduces classical music, has a good sense of rhythm, excellent pitch discrimination and tonal memory. Most of his time since the seventh year was devoted to piano practicing or listening to the radio. His playing is characterized as mechanical without emotional expression, style, deftness or technique. He does not *improvise or give interpretations or compose.* Although he has made music "the sole object of his existence" he cannot play popular songs, etc. on request, but only what comes to his mind. He fails on the Seashore Musical Aptitude Test; despite many variations and simplifications he cannot follow directions and also "perseverates" on all 6 parts of the test.

This case should be considered in conjunction with Minogue's 23 year old imbecile who also had suffered meningitis at 3 years.

Although he could play piano pieces by ear as well as from scores and had a remarkable memory for time, places, events and any composition he ever heard, he could *not improvise or compose.* Although he was able to play the piano without looking at the keys, i.e. by kinesthetic sense, his musicality and sense of rhythm were so specific that he could not dance nor learn it through instruction. ("He could not comprehend the relation of music and rhythm to his own movements.")

Subject E.V., C.A. 36, M.A. 4, can play the harmonica and drums, is chiefly fond of swing music, is "acquainted" with 10 or 12 of the popular bands. He constantly drums with his fingers, has a pronounced rhythmical ability. Although he received musical instruction, his musical capacity is restricted to a primitive level of reproducing tunes in which rhythm predominates. Compared to musicality in an average adult, his aptitude is inferior. He also fails on the Seashore Test in the same manner as subject G.X.

Subject D.W., C.A. 25, M.A. 8, draws and paints landscapes almost exclusively. His spontaneous products give the impression of some artistic ability but on the standardized Lewerenz Test in fundamental abilities of visual art he proves to be inferior to the comparable average adult.

Subject F.T., C.A. 17, M.A. 9, has drawing ability in pencil and crayon. On the Lewerenz Test she scores below average.

Subject J.P., C.A. 17, M.A. 9-2 is supposed to have mechanical ability according to the observations of his every-day behavior by the staff. On the Stenquist Mechanical Aptitude Test he scores within the 9 year level.

Subject E.Q., C.A. 33, M.A. 6-4, although he could make simple constructions of concrete objects with tinker toys such as a derrick or drill and showed mechanical sense beyond his mental age, his performance on the Stenquist Aptitude Test was inferior to the average 10-year-old boy.

Subject K.N., C.A. 19, M.A. 8-4, is very adept in sewing, embroidering and petit point, after having received instructions and having become the prize pupil of Letchworth in this work. On the I.E.R. mechanical aptitude test for girls she obtains a score below the average 6-grade pupil.

Evidently there exists for the same aptitude a marked difference between the performance in a standardized test situation and a performance in a "free" situa-

tion which is more natural to these aments. Regarding the nature of the intelligence defects, Rothstein's analysis of the sub-test results on various intelligence tests leaves no doubt that all his subjects were handicapped in abstract capacity. He refers explicitly to failure in symbolic and abstract comprehension and he explains the discrepancy between the behavior in free situations and on standard tests as a result of the highly specific and narrow range of the particular ability in the respective aments. Because he tried to solve his problem on a quantitative level he did not attempt a broader explanation of his findings. These results confirm in terms of psychological *measurement* our hypothesis of the peculiar limitations of talent in abstract impairment. Qualitatively, however, one could evaluate the results as follows: the procedure through which the aptitude can express itself is not flexible enough to permit successful adjustment to the formalized demands of the standard tests. The aptitude can only express itself in situations which have a concrete sense for the ament. This rigid concreteness is the sequel to the abstract impairment which prevents him from voluntary control of the aptitude and from wilfully assuming the necessary mental sets as well as from following the instructions. The "narrow and specific range" of the aptitude is a *consequence* of this impairment, not the characteristic of the aptitude per se.

There are other cases on record in which a special aptitude is displayed in the above characterized sense and where there is definite evidence of abstract impairment. We should like to deal here with two cases described by Parker because she presented a rather detailed study of them (45, 46).

The first concerns a mongoloid low-grade imbecile of 10 years who had an extraordinary sense of rhythm and audio-motor memory for words and tunes. "His mind was a veritable storehouse of verbal images." He retains nonsense jingles, college yells and rhymes almost on a single hearing. He hums arias and melodies. Upon 6 or 7 readings of a story containing 515 words he repeats it almost verbatim, reproducing 45% of the words proper, and 33% after three months' interval. After two readings of a story of 409 words he recalls 45% verbatim. He recalls poetry after 12 months' interval having reproduced it only once. He reproduces 26 stories verbatim almost in toto upon a retest of his first recall months ago. He repeats fragments of conversation faultlessly, not to speak of awkward phrases such as "King, Leodogrance of Cameliard". He is fascinated with sounds and will repeat over and again certain words and sentences which appeal to him phonetically. Although possessing a tremendous fund of words he excels in a stilted style of language often using expressions which betray a lack of real comprehension, as for example: "I did not like to stay in bed, it was so tedious . . . heroes are mighty and strong . . . we saw a whole cattle of cows" (after returning from an outing). In contrast with his verbal retentivity and facility, he lacks a genuine understanding of the semantic meaning of language and evinces the following symptoms of abstract impairment: he cannot dress himself, does not pick up by himself a blown-off hat. He has no sense of position concerning right, left, top, bottom, shows total number deficiency. He cannot "reverse" logical relations.

In class he could be taught to know answers in geography, such as: (1) Mexico is a republic. (2) USA is a republic.

Q. What republics do you know?

A. Visible signs of extreme distress, no answer.

Q. Which rivers flow into the Mississippi?

A. He enumerates correctly what he had learned, including the Ohio River.

Q. Into what does the Ohio River flow?

A. He cannot answer.

"He cannot bring together two sequences

[9] Parkers own psychological theory about these cases differs from our position (see page 42 of this monograph). The striking agreement between her observational protocols and our own findings seems all the more important.

which have a single term in common."

Q. Into what does the Mississippi River flow?

A. Into the gulf of Mexico.

Q. Into what does the Rio Grande flow?

A. Into the Gulf of Mexico.

Q. What two rivers do you know that flow into the Gulf of Mexico?

A. He cannot answer:

"He cannot hold a group of ideas in his mind under a single category." He knows: Georgia is in the USA, New York is in the USA, Pennsylvania is in the USA, "but is wholly lacking in the conception of them all as having a common quality of statehood, all parts of one country."

Correspondingly, his interest in other children is completely absent and except for enjoying approval for his feats, his social interest and understanding is practically nil.

He tells time "as a purely mechanical acquirement" from the position of the hands on the watch face, e.g. "it's ten after five." When someone says ten minutes after five, he is amazed, "What does ten minutes after five mean?" he asks. He cannot tell time if the minute hand is between the full 5 minutes step interval. He has poor visual imagery, a record of 1044 verbal utterances shows only 15 of distinctly visual content. He shows 50% less retention of picture details than other imbeciles. In contrast to his astounding verbal retention in "free" situations which appeal to his love for sounds and words, his memory on the standard tests is just normal: digit span five, disconnected monosyllables four, syllable in a sentence ten, etc.

The above record speaks for itself and it seems unnecessary to belabor the points of congruence with our own case and our explanatory hypothesis. The second report of Parker's supplements this picture by presenting a case of "numerical obsession." (45)

O., a boy of 6 years, was classified a high grade imbecile in spite of his I.Q. of 91.6 on the Binet. His basal age was III, his terminal age IX. In analyzing O.'s Binet performance, Parker attributes O.'s successes above the basal age to "abnormal numerical ability" and "subnormal subjections to the habit of echolalia." In conclusion she points out: "The rating of O.'s responses to the Stanford Revision of the Binet scale—strikingly illustrates how in certain exceptional cases the indiscriminate acceptance of the technical rating might lead to a false diagnosis. . . . The I.Q. was not decisive one way or another, it left the case where it stood." The specific abilities which won him credit on the test, weighting his basal age of III to a seemingly normal level were expressed as follows: O. mastered 5 digits forward, 3 backward, numbering of fingers, naming coins, reciting lists of days and months, repeating sentences up to 18 syllables. In contrast he could not understand the situation in the problem of "making change", barely passed the 3 year level in comprehension and in the description of pictures; he showed no discrimination of esthetic differences, no estimate of weights, length of lines or of quantity, failed in the choice between left and right. He failed on mutilated pictures and on *all* tasks of definition. His inability to understand imaginary situations is illustrated by this dialogue during the test "WHAT MUST YOU DO . . . when you are hungry?"

A. Eat. Q. . . . when you are cold. A. Go out. Q. Why? A. because you play.

Q. . . . if it is raining? A. play out. Q. If you find the house on fire? A. burn.

Q. . . . if you ruin your car. A. something —nothing.

Concomitant with the typical symptomatology of impaired abstraction O. was a problem child in school, was addicted to outbursts, shrieking monologues, "echolalia," showed no awareness of social relations to children or adults, never played with toys, never touched anything, could not dress and undress; he showed no interest in learning to read or spell, complying here only under tremendous pressure. Similar to L., O. became more and more sociable and manageable with increasing age and education. Characteristically, however, he never learns to play ball as a give and take game. He cannot learn to aim the ball, but always tosses it up, instead of out, so that the ball falls beside him. Instead of catching the ball, he sends it off with hands close to the chin. He never runs after a ball unless told to do so and then will throw it in a direc-

tion altogether away from his playmate. He cannot hit a large tree with the ball in a distance of 12 inches. Characteristically, this ineptitude decreased when he was given a *large* air-inflated rubber balloon. Parallel to this abstract deficiency in visuo-motor performances, he mixes pronouns in his syntax, says "I" for "you" and you for I (as L. did initially). Also O. likes to listen to music, but his sole interest is counting, perpetually translating everything into numbers. O. preferably counts minutes, corridors, windows, floors, steps, book pages. In learning perforce to read he says: " 'Must' is on page 47." He learns to assemble puzzle pictures of animals and their names only after he discovered he could *count* the completed animals. He refuses to describe pictures, but counts the objects on them, e.g. the legs of horses. Being asked after returning from a walk: What did you see on your walk today?, he answers, "Three things, six things." His world consists of objects and time to be counted. He always welcomes his father with the cordial question: "What time is favver going?" After a meal he says: "O. took 92 mouths full to eat supper—you had 24 raisins in your tart." At mealtime he goes into tantrums when the food is not served exactly on the minute. This is not "due to hunger or his love for food, but to a strange passion for promptness and computation. Once when sick in bed his dinner tray was brought to him 10 minutes of one o'clock. He refused to touch it before 1:00, the scheduled hour for dinner." Returning from outdoors before dinner-time he will typically soliloquize: "It's ¼ of 6, you have been out how long? You have been out since ¼ of 5. You have been out one hour. Supper is ½ past 6. In ¾ of an hour O. is going to have supper. ¾ of an hour is 45 minutes." To questions that did not have anything to do with numbers or food it was difficult to get anything from him, but random answers.

The following dialogue is typical (after he wandered out of bounds). Q. Why did you go into the front yard? A. "Because you were in the front yard." (you is always I). Q. *Why* were you there? A. "Because you asked K . . . what time it was." Q. Yes, but *why?* A. "Because it was 10 minutes of 11, because John is in that room, because it was about a minute ago." He counts and divides hours into minutes, minutes into seconds and seconds into half seconds.

One could ask whether we are here dealing with a neurotic obsession or with our suggested "funneling" of adjustment through the exercise of an initial endowment. The answer may be provided by the fact that O. shows a definite ability in counting and grouping before he has reecived any instruction. This is discovered by using a pegboard with 36 holes arranged in 6 x 6 rows. He quickly counts the 36 holes by encompassing groups of 3 as units and counting by ones from 12 to 36. Soon he masters the pegboard in units of 6, multiplies by consecutively adding 6 and so forth. In this way he also answers to "how many hours are there in 5 days?", by grouping as follows: "48-96-98-100-110-112-114-116-118-*120.*" He solves questions very often *with finger movements always counting aloud or counting under his breath.* Thus he answers to: "Take away 5 from 18" with "17-16-15-14-13"; to "take away 2 from 45" with "44-43." He fails, however, on "take away 12 from 45," getting lost in the sequence of his counting. But he solves such questions as: "If one apple costs 5¢, what will 5 apples cost?" by counting quickly in groups of 5 till 25. Q. "If one apple costs 6¢ what will 7 apples cost?" A. "6-12-18," he continues to count by ones with his fingers up to 24, then silently up to 42. He also can count in halfs, thirds, quarters, although he makes frequent mistakes and needs some prompting. The concrete origin of this counting was his spontaneous fractioning of time into half and quarter hours down to half minutes and seconds. Q. How many seconds in 50 minutes? A. "Thirty hundred." Q. How many seconds in 140 minutes? A. O. counts rapidly by 60's. "60-120-180"—silence—"three hundred"—long silence—"eighty two hundred seconds." (The correct answer is 8400.) Evi-

dently this dependency upon concrete verbal counting in grouping units is not reliable and leads to mistakes when *logical* relations are implied. O. tends to fail when:

(a) either the number relations overtax his grouping power or

(b) when the number order is related to another order, e.g. of yards, cents, etc.

(a) Q. What is 10 times 25? A. "250" (time almost one minute).

Q. 6 times 50? A. "300."

Q. 7 times 56? A. "Two fifty-sixes—. What is that?" He counts rapidly. "Two fifty-sixes, seven fifty-sixes"—He counts inaudibly "304".

Q. Wrong. A. "292." He cannot get it, begs to be told.—After being prompted in counting by halves and thirds he is asked:

Q. What is 1/3 of 30? A. 10. 1/3 of 60? A. 20. 1/3 of 93? A. 31 (after one minute). *1/3 of 105? A. 42 (fails after several trials).*

Q. What is ¼ of 8? A. 4.

Q. No, ¼ of 8 is 2. What is ¼ of 16? A. Failed.

Q. ¼ of 16 is 4. What is ¼ of 12? A. "3".

Q. What is ¼ of 36? A. 30.

Q. "No." A. (*Counted audibly by fours but did not get it*).

Q. What is ¼ of 24? A. 5.

Q. "No." A. Failed.

(b) Q. There are 365 days in one year. How many days are there in two years? He cannot answer this. Q. If one yard of cloth cost 15¢ how much will 4 yards cost? A. "15-30-*60*." Q. Sixty what? A. 60 feet. Q. No. A. "60 cents."

Q. If 5 pencils cost 25 cents, how much will one cost? A. "20 cents."

Q. No. (A. repeated). A. 26¢ Q. No. A. Oh, 5¢ Q. If 6 sticks of candy cost 12¢ what will one stick cost? A. 2 cents.

Q. If 8 sticks cost 24 cents, how much will 1 stick cost? He cannot answer this.

All these responses, whether "right" or "wrong," are obtained before O. had been taught an hour's arithmetic. There is then definite evidence of an initial gift for grouping in units, running in time. It is important to note that *most of his answers took time, up to several minutes, and that O. never departed from his specific, stepwise counting procedure.* He did, however, increase with practice the scope of his grouping units, reaching eventually units of 60 up to 300. He thus could *count* his way up to one half of 8211 in 3 minutes' time. His number sense never transcends this concrete basis, but leads to remarkable achievement considering his handicap to undestand relations between numbers in the abstract, outside of oral counting operations. As Parker pertinently summarizes, "He did not calculate in figures. In school they interested him no more than letters. For O. numbers were not figures but units and down that ever fascinating, ever lengthening infinite series, he could, in time, count his way to the solution of any problem . . . counting, perceptual counting must be the salient point in this transcript of behavior."

We have given a rather detailed account of Parker's records, because, in our opinion, the manifested abstract impairment and the anomalous manner in which the specific endowment operates in these handicapped personalities convincingly illustrate and substantiate our working hypothesis. Not only is the 'funneling' of O.'s motivation explicable from our concept of adjustment in these cases but also its boundless, uncontrollable and indiscriminating character. We are confronted with an analogue to "forced responsiveness" described in other abstract impairments (18, 22) the difference being that here the compulsion to respond is more occasioned by inner than by outer stimulation, namely by an initial propensity. Yet the basic cause is the same: the dysfunction of abstract attitude which *otherwise* controls, directs and integrates the natural impulses towards realizing one's capabilities.

The type of initial endowment here displayed requires some comments. It is questionable whether the procedure through which O.'s grouping ability expresses itself is typical of a particular stage in the *normal* development of number concepts in children as elaborated by Werner (61) and similarly by Riess (51). Of course Parker's records do not disclose all the psychological processes involved in O.'s counting; we do not know whether it operates through a purely oral medium or also through visualization, or to what degree his frequent use of finger movements commits him to the finger schema, and so forth. We do know, however, that his number manipulation consists of a stepwise counting, of grouping and re-grouping consecutive units varying in magnitude. We found that this procedure leads to inconsistent performances. Errors or difficulties in structuring his task occur when the number arrangements are too complex or when they symbolize an order of other measures (yard, cent, etc.).[10] This signalizes a dependency upon specific concreteness. To O. numbers seem to be concrete, thinglike structures, material units in a progressive quasi-spatial continuum. His numbers are concrete wholes to be arrayed in this continuum or subdivided into subwholes. It is this concrete schema of a continuum of successive wholes which O. utilizes to cope with his world by organizing everything possible into the only order that makes sense to him. At the same time this schema is an unreliable tool, because O. can get lost in it if it loses for him its concrete, palpable "surveyability." The following developmental characterization by Werner may come closest to this stage of number sense: ". . . a particular form is constructed which is to be used as a special means of numerical thinking. The concrete number construct becomes a *counting schema.* This schema is a means to impose mathematical order on concrete phenomena. Nevertheless, although it is the product of ordering mentality, it does not entirely lose its concrete character. At the beginning no schema is an abstract form, purely mathematical in its significance; it is a material vessel into which the concrete fullness of objects is poured, as it were in order to be measured" (61, p. 291).

It seems, then, that we have in O.'s number sense another striking instance where talent is rooted in a concrete patterning procedure and where the achievements attained through this Gestalt-like organization simulate an abstract level of reasoning. True, as compared to L., O.'s number sense seems more differentiated and flexible, shows less rigid limitation. Perhaps O.'s better visualization, e.g., his peg board and puzzle picture performances, account for his superior grouping ability and grasp of the number schema. Yet the unpredictable and desultory character of his successes and failures bespeaks the lack of abstract reasoning in terms of logical principles in his procedure. This commits him to an abnormally concrete conception of the meaning of numbers and to the one-track-mindedness of an 'amented talent'.

THE PROBLEM OF NUMBER MANIPULATION AND RETENTION IN TALENTED AMENTS AND IN MATHEMATICAL PRODIGIES

Its Developmental Significance

Parker raises the question whether O.'s *perceptual* counting talent might repre-

[10] Cf. Cases studied by Head (26) and Grünbaum (7) in which similar "symbolic" disturbances have been described.

sent the "chrysalis" of mathematical genius and she deplores the fact that we have no records of the development of great mathematicians. A comparative analysis of the development and the procedures in mathematical prodigies has however been carried out by Binet in 1894 (5), by Scripture in 1895 (55) Mitchell in 1906 (39) and recently by Brill (9). These studies answer Parker's question in different ways. It seems true that with its inception number sense expresses itself through certain concrete procedures. The talent manifests itself extremely often in the counting of objects *before* knowing numbers from education in arithmetic or in reading ciphers.

Ampère, Bidder Sr., and Mondeux began calculation by using pebbles, Le Coq by stringing beads, Zuccaro by using hazelnuts. Inaudi began counting at 6 as a shepherd while attending his father's sheep as also Pierini and Mangiamele did. *Counting* of minutes and seconds in a year, etc. is as common as telling the day of the week a given date falls (e.g. Mondeux, Fuller, Inaudi). Buxton, a day laborer, whose mentality has been described as not reaching that of a 10 year old boy and whose intelligence seemed not adequate to the ordinary matters of life, could *not* read or write. But he kept a mental record of all free beers since his twelfth year, counted the number of dance steps, of exits, entrances and words in a theatrical performance or the number of words in a sermon, the content of either he was unable to give. He knew the number of minutes in a year, of hair breadths in a mile, and calculated extremely slowly; e.g. he once mentally squared a number of 39 figures, being occupied with this for a period of 2½ months. His calculations never went beyond a primitive counting and grouping. Thus, instead of adding 2 zeros to multiply by hundred, he first multiplied by 5 then by 20. To multiply by 378, for instance, he multiplied successively by 5, 20 and 3 to get 300 times the number, then by 5 and 15 to get a second partial product and finally by 3 to complete the operation.

Also Brill's case, the 6 year old Jungreis, excelled in adding immense figures orally, before knowing written numbers. Initially he could only solve examples with concrete objects such as bananas or nuts.[11] "Abstract," i.e., plain, numbers meant nothing to him. He could only add but not subtract or multiply. Scripture's statement sums up pertinently the developmental factors involved in these prodigies who "learned numbers and their values *before* figures just as a child learns words and their meaning long before he can read. . . . The Roman Abacus, the Chinese swanpan and the success of the numeral-frames used in our primary schools, seems to point to the fact that it is best to teach 'calculation' (i.e., pebbling, from the Latin calculi, pebbles) before ciphering. The Arabic tsaphara, cipher, means empty; Arabic numeration however was considered mysterious by the people of the Middle Ages and remains mysterious to many a child of today. To the former (and also not seldom to the latter) 'ciphering' meant a secret and unintelligible process" (55, p. 59).

It seems further true that "there is nothing more striking about mathematical prodigies than their universal precocity" (Mitchell p. 96). In the documented cases the same author places the

[11] The concrete dependency on objects like apples, etc. in the first counting of children and the difficulty to transfer to plain numbers is well known (cf. Werner 61. P. 295.).

average age of the talent's appearance at 5½ years conservatively estimated. Of 24 calculators listed by Mitchell 18 were authentically and 2 probably precocious, showing remarkable ability *before* school age.

In addition many of the studied calculators were gifted in some particular medium of imagery related to numbers and their retention. It seems to be ascertained that Colburn, Inaudi and Safford excelled in auditory motor imagery and its utilization, also Mitchell classifies himself among this type. Bidder Sr., calculated with auditory images and used visual imagery in his memory for diagrams. Bidder Jr. and Diamandi employed visual, Finkelstein eidetic imagery (cf. Sandor (53), Bousfield and Barry (8)). One of the present writers (M.S.) had occasion to examine together with W. Stern and H. Werner at the Psychology department of Hamburg University a lightning calculator. In this case a visual-kinesthetic schema was used for retention of numbers which were remembered by their placement in the tridimensional space around the calculator; e.g. a number was left up or right down or behind up, etc. The case of an extraordinary memory for numbers, studied by Downey (12), also points to a preferred use of visualization in recalling numbers seen on automobiles, cash registers, etc. The subject showed a *below* average test performance on *orally* presented digits, but could retain 27 *visually* presented digits. He had developed interest in numbers as a brakeman on freight cars, leading him to organize their numbers into visual "groups as units". This enumeration does not include men like the illiterate former slave, Tom Fuller, whose mental calculations seem hardly possible without *auditory* motor imagery, and Dase, whose *visual* span could encompass some 30 objects at a glance giving instantaneously their correct number (books in case, a handful of peas, a herd of sheep).

One could, however, easily be misled if one were to conclude that productive mathematical capacity remains entirely dependent on such concrete grouping patterns and imagery. Though numerical ability develops frequently from a Gestalt-like process of grouping objects orally or visually, or within a palpable medium of imagery, this concrete stage can only be considered a stepping stone. Such concrete media facilitate number manipulation by providing anchorage-points and memory aids, but they do not provide the essential understanding of logical relations in the mathematical realm. Above all, the manner in which these grouping patterns or images are *utilized* for short-cuts, for mental diagrams and so forth, is co-determined by abstract thinking in terms of systematic planning and deliberate evoking of imagery.

It is further questionable whether phenomenal calculating power and mathematical talent in a broader sense are necessarily conjoined. In the literature the terms "mathematical" or "arithmetical" prodigy have been applied promiscuously to anyone who was precocious in numerical ability. Yet, the overwhelming majority of these prodigies were and became professional calculators rather than mathematicians. The instances of Pascal, Newton, Euler, the Bernouillis, to mention only a few, show further that mathematical talent is *not* necessarily dependent on precocity in calculation or coupled with preeminent power of mental arithmetic. Gauss' statement that Dase's 100 figure mental calcu-

lation which required 8¾ hours could be done on paper in about half the time illustrates the difference between a great calculator and a great mathematician. Thus Mitchell ranks Dase as the greatest of all calculators and at the same time asserts that he was "scarcely less stupid in mathematics than Fuller or Buxton" and could never be taught a foreign language. (p. 100) Scripture and Mitchell have made some initial steps towards differentiating great calculators from great mathematicians. Of all the prodigies listed, only four, Ampere, Gauss, Bidder, and Safford are credited with a combination of unusual mathematical ability and marked skill in mental calculation, but Ampere, Gauss, Safford were all around precocious.

It therefore may be psychologically important to distinguish between great mathematicians and prodigious calculators, both with regard to precocity and further development. Such a distinction may also lead to a better understanding of the desultory character of calculating ability in contrast to mathematical capacity with its more consistent development and interest. Brill has emphasized how calculating ability may appear in childhood and disappear afterwards as in Colburn, Jungreis, and Whately; that it may first appear after childhood as in Finkelstein; that it may develop in an original defective mentality or after an acquired mental defect as in Wizel's case. One could add to this that pronounced arithmetic skill may even develop after physical impairment, changing the individual's former mode of life, as in the blind Swiss Johannes Huber, etc.

To sum up, it appears that talent for calculation is generically rooted in a process of patterned grouping of concrete nature be it orally, visually, or auditory-motor. This process can, but need not develop into more abstract stages of arithmetical and mathematical understanding. This conclusion is supported by Mitchell's distinction of three grades of ability in the great calculators: "those of the first class never get beyond the stage of pure counting, though, of course, the counting process comes to be abbreviated more or less with practice. At this stage the point of view is not even arithmetical. The calculator thinks not of arithmetical operations but of *properties* of numbers and of series, and the shortcuts he uses are of a relatively simple sort, showing no mathematical insight." In those of the second class . . . "We find a fairly well developed knowledge of arithmetic and a distinctly arithmetical point of view; it is operation and calculation, rather than mere properties of numbers in which these men are interested." In the third class . . . "we find real mathematical ability, power to take a distinctly algebraic point of view, to generalize, and hence to discover all sorts of ingenious shortcuts and symmetries." (p. 101). This differentiation may help to elucidate the fact that, in a rudimentary, primitive form, calculating talent can be found in cases of mental deficiency. Mitchell's characterization of the first stage corresponds to our explanation of the concrete procedures dealing with numbers as wholes which have properties like objects, and of operating within a concrete schema of grouping patterns. It is this stage which Parker's case O. and our case L. have approximated but which they could not transcend because of their abstract impairment.

In this respect the problem of *memory* in such cases has arrested the attention of practically every writer who has occu-

pied himself with the subject. Why is memory for numbers so impressively combined with the endowment for mental arithmetic? Are we to assume with Binet that mental arithmetic combines two distinct and independent faculties, that of calculation and that of memory, and that it is the memory factor which distinguishes mental calculators from other individuals? Without entering the technical arguments of this discussion we deem it unnecessary to postulate here a special memory function and to separate it from the *process through which numbers are organized by the person and make sense to him.* To refute such postulates Mitchell cites among other examples Inaudi who remembered 200 or 300 numbers used in one of his public exhibitions because of "his *interest* in the figures on account of their connection with his calculations; where that interest was lacking he could only remember a third as many figures in the same period of time. . . . When he exceeded the range of his practice in calculation and passed from a five figure to a six figure multiplication, he required six times as long—a result inexplicable in a man who could retain 42 figures on a single hearing, if memory is the real secret." Mitchell's final comment on this issue in 1906 reads like anticipation of modern Gestalt views on learning: ". . . in short, figure memory is important in the psychology of mental calculation only in so far as it stands in the service of calculation and intimately bound up with it . . . a 20-figure number which for most of us is a meaningless string of figures, devoid of interest, for him 'makes sense', and so is easy to learn . . . the difference between the man who can unravel a half page sentence of technical German and the one who can scarcely understand a two line sentence is not primarily a matter of memory, but of interest and meaning, and the same holds good of the calculator who handles large numbers as compared to the one who does not" (pp. 116-18).

The Problem of Memory Organization in Certain Aments

Its Developmental Significance

The relation between meaning, interest and retentive mastery has so mystified Scripture that he speaks of "the union of ability to the inclination" as the "strangest of all" phenomena which here perplex the psychologist (p. 57). This "strangeness" might lose some of its vexing character if we were equipped to study the problem of specific memory and inclination with respect to the nature of meaning which specific contents and activities have for given individuals. The question so posed reaches beyond the scope of number sense and retention in prodigies or in mental defectives. The question bears directly on one phenomenon which emerges as an incontrovertible fact from numerous case records, including our own. In one form or another certain aments show striking retention of special data. Granting that the total memorial repertoire in these cases is subnormal and that the memory feats may only stand out by contrast to the remaining inanity, we are still faced with the psychological problem of this peculiar selective retention. Its frequency is substantiated by Tredgold, Barr, and numerous other authors[12] among whom William James was one of the first to observe: "Imbeciles sometimes have extraordinary desultory memory. What these cases show is that the mere organic retentiveness of a man need

[12] Jones (30) has abstracted pertinent quotations of many authors.

not bear a relationship to his mental powers" (29, I p. 660). Irrespective of this theoretical bias, experience has proved James right in calling attention to the fact. Reported memory peculiarities as authenticated in the literature on aments roughly cover the following range:

(1) Correct reproduction (immediate or delayed recall) of heard sentences in several foreign languages or mother tongue (4); of songs, melodies, hymns, poems; of entire book pages, news-paper columns once heard or read; of any biographical records read (59).

(2) Precise knowledge of places visited; of events, dates, minor occurrences in the home locality or institution over years; of the names of all visitors, attendants, physicians, inmates with dates of coming and going, length of residence through the years, and the birthdays of all inmates in the institutions. In one case the day when every person had been buried in the parish for 35 years, the name and age of the deceased, and the mourners at the funeral.) (59)

(3) Knowledge of railway time-tables; numbers on locomotives; automobile license numbers, figures on budget statistics (11,12,30,43); the calendar dates of weekdays from 1000 to 2000 A.D. (64), or during the last 4 to 5 years (28); the squares and cubes of numbers up to 100, etc.[13]

It should be pointed out that all these memory performances may be either incidentally acquired or through preoccupation; that the data retained are never understood in their normal meaning and frequently not at all. Now, it is obviously absurd to postulate here a manifold of specific memory faculties. But what is the explanation? It was our original hypothesis that a defective organism is abnormally driven to exercise those functions which nature and circumstances permit him to actualize in striving to cope with his world. His abstract impairment constricts and modifies his behavioral environment in such a manner that stimuli acquire a quality and valence different from that for a normal individual. Only stimulations which can be grasped and reacted to on an abnormally concrete level are within the scope of his responsiveness. This leads to a changed organization of experiences; to atypical perspectives of the environmental structure; to figure-ground constellations of material and of situations which deviate from the normal and bring other aspects into the foreground with which the defective organism can more easily come to terms. The defective organism must respond to those features of his behavioral world from which he can capture a concretely sensible aspect, with which he can deal successfully. He will cling tenaciously to whatever aspect he can organize into a concrete sense, i.e. to those performances which lead to the experience of success and mastery. These performances will become abnormally preferred and retained, because through these he can come to terms with a world that is beyond his grasping powers. Psychopathological observations have shown in general that patients have a much better memory for those events which they can grasp.

Initial individual differences may lead to differences in responsiveness and centering. For one defective individual, acoustic or musical sequences, for another, rhythmical, audio-motor patterns, for still another, unit-groupings, such as numbers or spelling letters will make

[13] This listing does not include memory performances already referred to in the preceding parts of this monograph.

concrete sense, and so forth. When we hear an ament recite newspaper columns or reel off historical dates or a time-table, we are tempted to interpret this in terms of a normal understanding of the objective content involved, whereas he has only absorbed that 'figural aspect' of the material which was concretely sensible to him, e.g. the sheer acoustic feature or the number configuration as a perceptual pattern, etc. This is to us an external contingency, but for the ament the only available sense. In short, we advance the hypothesis: the memory peculiarities in amentia result from a selective responsiveness to those aspects of material and of events which have concrete sense for the ament; which he therefore retains on his specific terms and which he tends to make the center of his performing. Though, in principle, this hypothesis is in keeping with observations on demented brain injured adults, there is one important difference. The ament starts out with an initial intellectual impairment in childhood and continues to mature and develop somehow. Therefore his impressionability and absorptive capacity differs from that of an adult who was normal in his premorbid state. The experienced contents which may appeal to the mentality of an amented child in making concrete sense to him and thereby entrench themselves in his memory, cannot be of the same substance and order that makes concrete sense to a mentality of a formerly normal, demented adult.

It is probable that also in the normal child the development of memory organization begins with a dependency upon the concrete grasp of contents. This would be quite in line with the over-all picture of a genetic sequence in mental development, particular in thinking and language, which Stern (57), Werner (61) and Piaget (44) have tried to formulate in varying terminology—each according to his theoretical conception. Specifically with regard to the development of retention there appears to emerge a body of facts converging towards some common principle. In its initial stages memory seems to hinge on the child's responsiveness to concrete situations and action contexts as well as on his greater impressionability with the palpable sense of material, such as perceptual qualities, of shape, color, sound, rhythm. Here the marked sensitivity to concrete grouping and readiness for acoustico-motor and kinesthetic patterns is a determining factor, especially in spontaneous retention. What is usually called the preponderance of "mechanical memory" in the early stages of language development is perhaps routed in the concrete functional sense which auditory motor Gestalten possess for the child (babbling, echolalia, metalalia, rhymes, indiscriminate word memory). The child may, through a different centering, be seeking out such aspects in the world around him and enjoy their mastery because others e.g. the precise meaning of a word or object are not yet within his grasp. Experiments by Brunswik (10) and the work of Werner (61) have produced evidence of a general developmental sequence in the child's memory from concrete features and configurations to the more abstract content and symbolic meaning. If these studies should be substantiated by future research,[14] we may find that the atypical memory organization in a subnormal child may represent a lawful modification of concrete stages in the normal development, having become patholog-

[14] Recent experiments by B. F. Riess point in this direction. Cf. "Genetic Changes in Semantic Conditioning." A paper read before E.P.A., April 6, 1945.

ically conditioned as a coping mechanism.

An abnormal development of memory organization as a coping mechanism may easily lead to miseducation. Experience with prodigies as well as with abnormal children seem (13) to indicate that a better balanced personality could have developed if parents or teachers had, in time, redirected the child's preoccupation into more normal channels.

Recently Kanner (32) has discussed 11 cases of personality deviation in children in terms of "autistic disturbances of affective contact" which he considers a special syndrome. Pointing to the misplaced eagerness of parents to promote precociousness in their children he states: "Their excellent rote memory, coupled with the inability to use language in any other way, often led the parents to stuff them with more and more verses, zoologic and botanic names, titles and composers of Victrola record pieces, and the like. Thus, from the start, language, which the children did not use for the purpose of communication—was deflected in a considerable measure to a self-sufficient, semantically and conversationally valueless or grossly distorted memory exercise. To a child 2 or 3 years old, all these words, numbers, and poems (questions and answers of the Presbyterian Catechism; Mendelssohn's violin concerto; the twenty-third Psalm; a French lullaby; an encyclopedia index page) could hardly have more meaning than sets of nonsense syllables to adults. It is difficult to know for certain whether the stuffing as such has contributed essentially to the course of the psychopathological condition. But it is also difficult to imagine that it did not cut deeply into the development of language as a tool for receiving and imparting meaningful messages".

Kanner's behavioral observations in these children represent new valuable material for mental pathology. Since his case histories show many parallels to those here presented it may be in order to make some comparisons between his interpretation and our hypothesis on the role of concreteness in defective children and their retentivity.

According to Kanner "the outstanding, 'pathognomic', fundamental disorder is the children's *inability to relate themselves* in the ordinary way to people and situations from the beginning of life" (p. 242). He explains all behavioral abnormalities found in these children from their *affective* disturbance, from their "desire for aloneness and sameness". To Kanner the inconsistent picture of intellectual ability, the obsessive repetitiousness, the shock reactions to loud noises and moving objects, and the "truly phenomenal memory" in these children is accounted for by their emotional resistance against change in the outer situation—the insistence upon "identical spatial or chronological order". In following Kanner's impressive observations in support of his view, it appears nevertheless as if Kanner has neglected the qualitative nature of the intellectual abnormalities in this picture. The case histories abound with instances of compulsive concreteness in thought and action. In our opinion this is only explicable on the basis of an impairment of abstract attitude which is intimately bound up with the affective disturbance. To mention only a few problems, it is hard to see how an affective disturbance alone can account for what Kanner calls the "literalness" in these children, their inability to use "yes" as a *general* symbol of affirmation, detached from the specific situation in which it had been acquired; their inability to understand prepositions in the

abstract sense. (Asked to put something down, the child puts it on the floor—understanding the word only in the originally acquired situational sense.) It is hard to follow Kanner when he makes the affect-anomaly responsible for: "the absence of spontaneous sentence formation and the echolalia type of reproduction, which in every one of the 8 speaking children has given rise to a peculiar grammatical phenomenon. *Personal pronouns are repeated just as heard.* The child once told by his mother 'now I will give you your milk' expresses the desire for milk in exactly the same words. Consequently he comes to speak of himself always as you and of the person addressed as I." We have encountered this reversal of pronouns in three cases here presented all of which showed pronounced impairment of abstraction.

This peculiar "grammatical" phenomenon appears to be more than a mere grammatical one or a purely mechanical echolalia. The child hears himself addressed as "you" and the other person speaking of himself as "I". Only on a concrete level of thinking is the literal application of the word "you" to the child himself and "I" to the other person explicable, because the child cannot detach the words from their experienced "belongingness" in the actual situation and reverse this belonging in terms of a relational symbol. (The corresponding phenomenon in normal children is their frequent use of their first name or the third person in referring to themselves.)

Is the child's inability to shift the word "you" from himself to the other person, and the word "I" from the other person to himself, is this inability to grasp the relational meaning of "you" and "I" in the abstract, merely the result of the affective disturbance or not a symptom of impaired abstraction and limitation to the concrete as well?

In discussing their peculiar memory Kanner speaks of parrot-like repetitions of heard word combinations, of "delayed echolalia".

As in the case of L., "the children had learned at an early age to repeat an inordinate number of nursery rhymes, prayers, lists of animals, the roster of presidents, the alphabet forward and backward, foreign (French) language lullabies . . . even long and unusual words were retained with remarkable facility". Yet in contrast to these recitals, their spontaneous language-development and understanding was retarded. In Kanner's concepts it is the need for "sameness and autistic aloneness" that sufficiently accounts for both, this semantic retardation and for the abnormal retention of verbal material, which latter he characterizes as completely senseless for the children. This makes it quite difficult to understand *why* they so eagerly and readily absorbed and reproduced such material, and even liked to spell out words. Is perhaps the fact that the children did not grasp the meaning of language in the normal way, the motive for their heightened responsiveness to and their tenaciously obsessive reproduction of phonetic sound patterns? In the light of our own case-material it seems highly probably that these children excelled precociously in verbal memory for the same reasons as we outlined in our hypothesis. And the question may arise, whether the disturbance in affective human contact they suffered is not secondary to the defect in abstraction or parallel to it. Perhaps this hindered a normal grasp of the semantic aspect of language and impelled these children to cling to that aspect of speech which was concretely sensible and apprehensible for them in terms of auditory motor patterns.

IV. Summary

L. an 11-year-old boy, with behavioral peculiarities has been studied over a period of 5 years and a reliable record of his previous development obtained. L. showed distinct musical aptitude—he played melodies on the piano by ear—and was remarkable in verbal retentiveness. His skill in rapidly manipulating simple numbers was also unusual, and he performed so-called calendar calculations amazingly well. Numbers he remembered with the same ease as occurrences which to his mind had once become connected with them, so that he volunteered dates, names, places and time of events at the slightest provocation.

In spite of all this, L.'s general information was surprisingly subnormal, and, with the exception of the just mentioned aspects of his surrounding, nothing aroused his interest. He never absorbed or learned in a normal fashion, nor could he attend a regular school. He was retarded in the mastery of many skills, commensurate to his age, and he was lacking in social awareness with a limited repertoire of social responses. L. had an I.Q. of 50 which classifies him technically an "idiot-savant."

An investigation of L.'s personality structure was carried out with specially devised experiments, with standard tests and with careful exploration of his spontaneous behavior in every day life. An analysis of all data and of the findings in multiform performance fields failed to disclose an individual segmental defect or several specific defects. Instead, his various deficiency symptoms pointed to a functionally common disturbance, a general impairment of abstract capacity (e.g. in the semantic use and ideational understanding of language, of social contents and relations; in reasoning, in the grasp of causation, of logical meaning, of symbols, of conceptual number relations; in the cognitive structuring of visual performances and visuo-motor tasks). This picture of general abstract impairment was corroborated by the experimental evidence that L. succeeded in his own performance-specialties without having a genuine understanding of their meaning as to content and implication. Further exploration of his thinking, learning and social behavior revealed an abnormal concretization. He could only grasp and learn what made situational or tangibly patterned sense to him. Otherwise, if he retained at all, it was in an automatic, associative manner by habituation.

A positive evaluation of his successful performances, abilities and skills was attempted. After having experimentally ruled out other alternatives, it was found that L. possesses an initial endowment in the acoustic and audio-motor sphere, probably supported by kindred imagery. This endowment expressed itself particularly in his sensory motor receptiveness for melodies, i.e. for acoustic "Gestalten" and for verbal patterns. On this basis his musical performances, his verbal and tonal memory (absolute pitch), and his aptitude for serial grouping became explicable (e.g. his rapid oral counting and spelling, forward and backward, his large digit span and his calendar performance).

Further analysis of his procedure in the utilization of this endowment revealed however, that it did not operate in a normal manner. It was bound to an abnormally rigid concreteness and func-

tioned in a sterile, bizarre and undiscerning form. Symptomatically, in music he could not develop his talent through study or practice. His performances were desultory, depending on specific circumstances and his interest ranged from obsession with a special phonograph record to appreciative enjoyment of opera arias or Haendel's "Largo" on records and indifference to *any* radio music. Correspondingly anomalous function of his talent was manifest in his excessive tendency to count indiscriminately, and to resort to enumerative verbalization and inane speech clichés whenever he was confronted with a task that overtaxed his power.

We find then that an individual who is handicapped in abstraction and endowed in a particular field of performance shows a *sub*normal intelligence and an *ab*normal canalization of his endowment. In interpreting this personality picture we concluded: owing to his impaired abstract attitude, L. cannot realize his remaining potentialities in a normally integrated manner. He is therefore driven in an abnormal degree and direction to exercise those functions which nature permits him to develop, because these are the only performances through which he can actualize himself and come to terms with his surroundings. The least impaired function thus becomes a coping mechanism of adjustment, but, since it can only operate on the level of concrete reactions, it becomes canalized into atypical forms of expression. This result seems to point to an organizational interdependence of basic psychological functions. Certain pertinent implications with regard to normal personality structure and with regard to the problem of idiot savant are discussed and the following generalizations considered:

1) How an endowment operates and develops, depends upon the organization of the person as-a-whole.

2) There exists a functional interrelation between abstract capacity, intelligence and special endowment.

a) The abstract capacity is essential for the normal functioning of intelligence. The bearing of this on the association theory of intelligence is followed up.

b) The abstract capacity is conditional for the normal functioning and development of an endowment, although the latter may be anchored in concrete processes, e.g. of Gestalt type.

3) The term idiot savant is a misnomer. Idiot savants are talented aments who possess an amented talent.

In order to test these conclusions a comparative study of other reported cases of idiot savant was undertaken and various explanatory hypotheses of other authors were critically examined. The evaluation of this case material seems to confirm our interpretation, since no cases were found in which a talent functioned normally in an individual with abstract impairment. These led to the establishment of certain criteria for the psychological identification of a talented ament.

In studying the reported superior abilities in aments two phenomena invited particular attention because they posed an intriguing psychological problem. These were (1) the relative frequency of number manipulation and retention, and (2) unusual features of memory.

(1) The analysis of the psychological processes involved in these number performances laid bare their origin in concrete perceptual counting procedures with specific limitations. A comparison between this stage of primitive, concrete grouping and the initial procedures in arithmetical prodigies showed basically

common characteristics. It became clear, however, that the arithmetical prodigy who developed further towards a cognitive understanding of mathematics outgrew this original stage of concrete dependency in his number operations, because he could increasingly adopt an abstract approach. In contrast the abstract impairment prevented the talented ament from passing beyond the initial stage of concrete grouping procedures.

(2) The striking retention of numbers or of outlandish and irrelevant data, as, e.g., railroad tables or an entire newspaper column, is all the more surprising as in most every instance the retained material is not understood by the ament in a normal way. A psychological appraisal of the changes in figure-ground organization as experienced during pathological concreteness led us to set forth a new explanation of these peculiar memory processes. The observations on the cases studied indicate that a defective organism will cling tenaciously to those aspects of a situation and those features of material which make concrete palpable sense to him, i.e., with which he can deal successfully. These aspects are thrust into the foreground of the phenomenal organization as the "figure". Such a difference in perceptive centering in the abnormal's coming to terms with the world of the "normal" leads to a different centering of performance. Therefore, these aments retain easily what may appear senseless or peripheral or irrelevant to the normal observer. To the aments in question, however, this is the only "sense" possible and pivotal in the experienced contents. This explanatory attempt is tested on diversified case material. Finally, comparing abnormal concreteness in aments with stages of concrete reaction in normal children the following question is raised: Does the atypical memory organization in a subnormal child represent a lawful modification of a normal development phase which has become pathologically "eccentric" and conditioned as a coping mechanism?

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NOTE: After this monograph had gone to press, an article by A. Dudley Robert appeared in the *Journal of Genetic Psychology*, 1945, 66, pp. 259-265, entitled "Case History of a So-called Idiot-Savant." It deals with a 29-year-old man who was medically diagnosed as a quadriplegic spastic and whose pneumoencephalogram indicated cerebral pathology. The case belongs in the category of those feeble minded who do calendar calculations on the basis of eidetic imagery as mentioned in our survey of other cases. In principle Robert's interpretation is in agreement with the one presented here. Roberts concludes: "This patient, limited both in the number of visual experiences and in the acquisition of language, may have thus retained eidetic imagery into his adult life through continued use and because of its usefulness to him."